MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE

KHARKIV NATIONAL UNIVERSITY OF ECONOMICS

Guidelines to laboratory works on the academic discipline "STATISTICS"

for full-time students of training direction 6.030601 "Management" of the specialization "Business Administration" and of training direction 6.140103 "Tourism"

Харків. Вид. ХНЕУ, 2013

Затверджено на засіданні кафедри статистики та економічного прогнозування.

Протокол № 13 від 29.05.2013 р.

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G94 Guidelines to laboratory works on the academic discipline "Statistics" for full-time students of training direction 6.030601 "Management" of the specialization "Business Administration" and of training direction 6.140103 "Tourism" / compiled by O. Rayevnyeva, I. Serova, O. Bobkova et al. – Kh. : Publishing House of KhNUE, 2013. – 60 p. (English)

Laboratory works on the academic discipline and guidelines to their implementation are given to help the students acquire the fundamentals of using the methods of the theory of statistics for analytical assessment of information in tourism.

Recommended for students of the specialization "Business Administration".

Наведено лабораторні роботи з навчальної дисципліни та методичні рекомендації до їх виконання, які сприяють засвоєнню студентами основ використання методів теорії статистики з метою аналітичної оцінки інформації в галузі туризму.

Рекомендовано для студентів спеціалізації "Бізнес-адміністрування".

Introduction

The implementation of laboratory works is aimed at developing students' skills of using statistical methods of analysis of distribution series. The laboratory works assume their mastering the fundaments of MS Excel package, i.e. building, the automation of conservative calculations and charts the incremental implementation of tasks, the essence of statistical methods of analysis of distribution series etc.

While carrying out the laboratory work each student should use a particular book of Excel (recorded in a separate file). In addition, each task is performed on a separate page of the book. In the cell A1 of each sheet the number and title of the work should be mentioned. For example: Laboratory work No. 1. Overview of Excel. Each page of the book should contain the number of the task, e.g. Task 2.3. Each file name should include the name of a student and the work title, for example, Ivanov – 3. For each paper the student must submit a report that contains the title of the work, and tasks results. For questions that are given in the tasks, but do not require calculations and constructions, a student must prepare a recitation.

Qualification requirements for the students in the area of Statistics

Knowledge base necessary for studying the discipline

In order to better understand the educational material of the academic discipline, students must first acquire knowledge and skills in the field of general theory of Statistics, Economic and Mathematical Modelling. In turn, the knowledge of the studied discipline provide successful performing the projects by the students. While studying of the academic discipline "Statistics" students should acquire the following skills (Table 1.1).

Table 1.1

Competencies to be formed while performing laboratory works on "Statistics"

The name of a competency	The content of a competency	The ability of a student in regard to this competency
1	2	3
1. Accounting and statistics	1.1. The ability to conduct statistical calculations	1.1.1. Carrying out the calculation of indicators for checking statistical hypotheses. 1.1.2. Carrying out the calculation of time series indicators

Table 1.1 (the end)

1	2	3
2. Analytical	2.1. The ability to conduct a statistical analysis	2.1.1. Identifying the factors that influence the change indicators. 2.1.2. Forecasting the run of the processes analyzing and evaluating possible consequences of changeable conditions
3. Organizational and methodological	3.1. The ability to apply the statistical methodology	3.1.1. Own methods of forecasting. 3.1.2. Own research methods of the types of economic and social phenomena. 3.1.3. Own methods of assessing the general trend of phenomenon. 3.1.4. Own methods of assessing the stochastic phenomena. 3.1.5. Own methods of forecasting based on trend extrapolation models. 3.1.6. Own methods of vibration and dynamic series consistency. 3.1.7. Own methods of constructing the univariate and multivariate regression models. 3.1.8. Own methods of constructing the autocorrelation
4. Control	4.1. The ability to build single-factor and multi-factor models and check them for compliance	4.1.1. Preparing the information choosing the type of models, carrying out the calculations of their parameters and checking them for compliance. 4.1.2. Using the appropriate criteria for analysis of the level of the authenticity of forecasting the estimates
5. Information	5.1. The ability to use modern means of information processing for solving the economic tasks	5.1.1. Using a variety of features of the Excel application package for visualization systems analysis of economic processes or phenomena in order to enhance the quality of management decisions

Laboratory work No. 1
Overview of Excel

The purpose of this work is acquiring the skills of operating the MS Excel spreadsheet.

Its task is to learn the basics of using a spreadsheet: introduction and editing of data formatting, designing tables.

Guidelines

The Excel is a program that belongs to the category of spreadsheets and is a part of Microsoft Office package. One of the main advantages of Excel is its generosity. There are several possible applications of Excel. Among them are:

1) the solution of numeric problems that require time-consuming calculations, such as reporting, analysis of research results, and the use of different methods of financial analysis;

2) creating charts. Excel contains tools to create different types of charts;

3) the organization lists. Excel allows you to efficiently create and use structured tables, the columns of which contain the similar type of data;

4) access to the data of other types and the ability to import data from many different sources;

5) creating drawings and charts. Using Excel AutoShapes to create simple (and complex) schemes;

6) automation of complex tasks by means of Excel macros, i.e. one can perform the same type of tasks with one click.

Workbook and worksheet

All the actions performed in Excel, are saved in the workbook, which opens in a separate window. By default, the workbook files have the XLS extension.

Each workbook contains one or more worksheets, each consisting of individual cells. The cell can store a number, a formula or a text. To move from one worksheet to another, you need to click on the appropriate sheet tab, which is located at the bottom of the workbook. Furthermore, a workbook can contain chart sheets, each of them including one chart. One can go to the chart sheet by clicking on its label.

In Fig. 1.1 the most important elements of Excel window are shown.

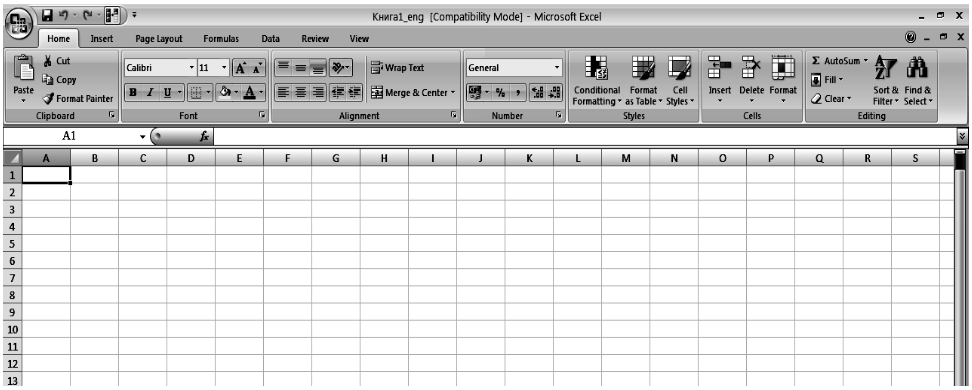


Fig. 1.1. **The most important elements of Excel window**

Moving within the worksheet

Each worksheet consists of rows (numbered from 1 to 65.536) and columns (denoted by the letters A through IV). The column Z is followed by the column AA, AZ – by VA, etc. At the intersection of a row and a column there is single cell. At the moment, only one cell can be active. The active cell has dark contour (Fig. 1.2).

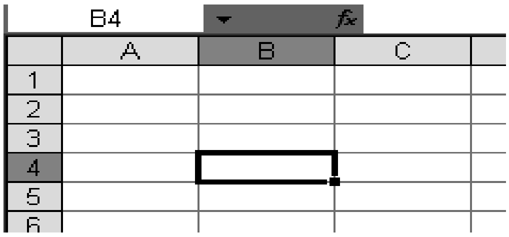


Fig. 1.2. **The active cell**

Its address, i.e. the column letter and the row number is specified in the **Name** field. Depending on the chosen method of moving to the workbook the active cell can move or remain unchanged. The titles of a row and a column at the intersection of which the active cell is are marked by dark colours.

Using the keyboard

To move within the worksheet, you can use the cursor keys. Pressing the "↓" key moves the table's cursor one row lower, pressing the "→" key moves one column to the right, etc.

<Num Lock> button controls the buttons on an additional digital keypad. When the Num Lock indicator is on, Excel highlights in the status bar **NUM** label. In this case, the additional digital keypad can be entered directly.

Using a mouse

Moving within the worksheet with the help of a mouse also occurs as it might have been expected. To change the active cell, one should click the desired cell, and it will be active. If the cell that you want to activate is, not visible in the workbook, one can use the scrollbar to scroll the window in any direction.

When the scrollbars or scrolling through IntelliMouse are used an active cell does not change, only the worksheet scrolls. To change the active cell it is necessary to click on a new cell after scrolling.

Using menus and toolbars

If you have worked in any program before, then you should not have any problems when working in Excel. The user interface is Excel (that is, the menu and the toolbar) will look familiar, so far as the location and purpose of instructions in all the programs are the same.

Using the menu

In Excel, as in all other Windows applications, there is a menu bar, located below the title bar (Fig. 1.3). Excel menu changes depending on the nature of your actions. For example, if you are working with a chart, the Excel menu adjusts so that to give you tools to work with charts.

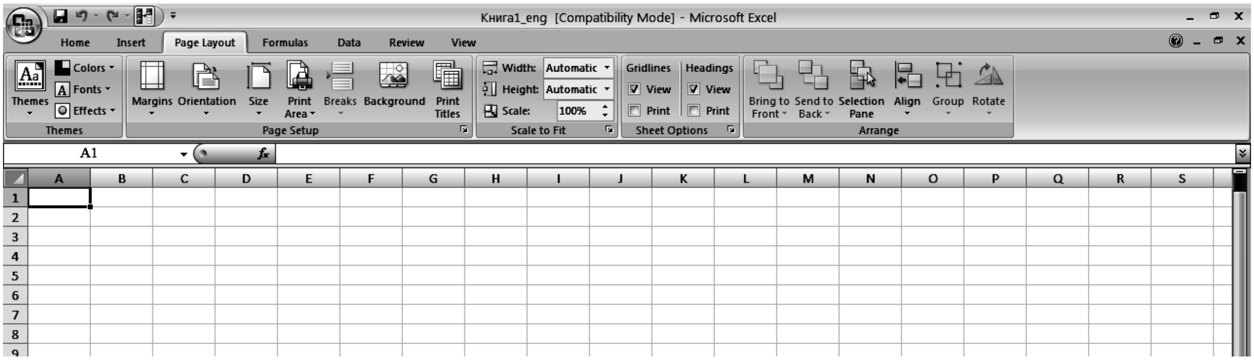


Fig. 1.3. **Excel menus and submenus**

There is nothing easier than to get access to the menu with the help of a mouse. Click on the required menu, it will open and you will see a list of its elements (see Fig. 1.3). Some menu items have additional submenus. If you click on such menu item, the submenu will appear on the right side of it. Menu items that have a submenu are marked with a small triangle on the right side. For example, the **View** Toolbars submenu is shown in Fig. 1.3. Sometimes a menu item is highlighted with gray colour. This is the way to indicate that this item is not designed for the operation you are performing at the moment.

Selecting a menu item, the name of which includes the ellipsis (three dots), always results in the dialog box opening. Menu commands that have no ellipses are executed immediately. For example, when you select **Insert > Cells** ... a dialog box appears, because the program needs more information about the executed command. The **Insert > String** command does not need any additional information, so it is executed as soon as it has been chosen. Almost any command in Excel can be disabled with the **Corrections > Undo** command. Thus, you can undo the last 16 executed commands. Instead of choosing the **Corrections > Undo** command**,** you can use the **Undo** button, which is located on the standard toolbar. In addition, to undo the last action you can use the key combination <Ctrl+Z>.

Using the context menus

In addition to the main menu Excel provides many other context menus. These menus are context-sensitive, that is, their content depends on the nature of the operation that you are performing at the moment. There are only the commands that are most commonly used to work with the selected element at this point. The context menu can be called for almost any object in Excel. To do this, click on the right mouse button. In Fig. 1.4 the context menu that appears when you right-click on the cell is shown.

The use of key combinations

For some menu items the shortcuts are provided. Usually a key combination is shown next to the name of the menu item. For example, the keyboard equivalent of the **Corrections > Find** command is the combination <Ctrl+F>. The combinations of frequently used commands you can see in the menu to the right of their names.

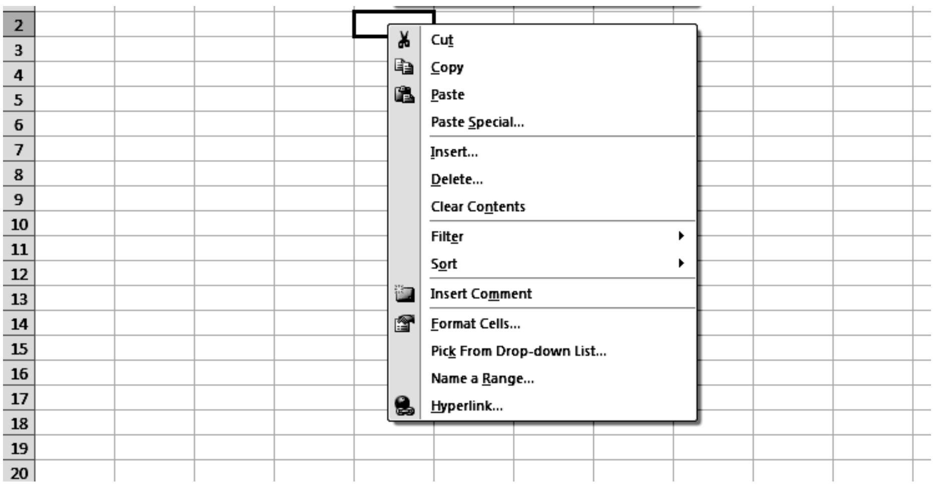


Fig. 1.4. **The context menu**

Excel toolbars

Excel, as almost all modern applications, includes a handy graphic toolbar. Most of the toolbar buttons replace some of the menu commands. For example, the **Copy** button replaces the **Corrections > Copy** command. However, some buttons do not have equivalents in the menu, such as **AutoSum** button, which automatically inserts the formula for calculating the sum of the values in a specified range of cells.

To find out what this or that toolbar button is meant for move the mouse pointer to it (but do not click on it). Next to the cursor appears a small yellow window with tip that contains the name of a button. If a tip is not seen on the screen, select the **Tools > Setting up** command. In the window that appears, navigate to the tab **Options** and select the **Display button tool tips**.

Table. 1.2 lists the most commonly used built-in Excel toolbars.

Hiding and displaying toolbars

By default, Excel displays two toolbars – standard and formatting ones. In addition, you can create your own toolbars, which will consist of the buttons that you find most useful.

Table 1.2

Excel toolbars

Name	Characteristics
Standard	Running the most frequently used commands
Formatting	Changing the appearance of a worksheet or chart
WordArt	Inserting or editing an artistic text
Web site	Access to the Internet with Excel
Border	Adding border (frame) around the selected cells
Charts	Working with charts
Dependences	Identifying errors in the worksheet and displaying the relationships between formulas
Protection	Management of protected worksheets and books
Peer review	Operations with the notes to the cells
Drawing	Inserting and editing pictures on a worksheet
Pivot tables	Working with pivot tables
Forms	Adding to the worksheet controls (buttons, lists, etc.)

To hide a toolbar, or display it on the screen, choose **View > Toolbars** or right-click any toolbar or the menu bar. The result is a list of toolbars. The toolbar, activated in the list is visible. To hide the toolbar, one should click on its name in the list. And vice versa to show a hidden toolbar, you can also click on its name.

To access all the toolbar, choose **Service > Settings**. The **Toolbar** tab of the dialog box appears on the screen **Settings** for a list of available toolbars. Check the boxes next to each panel to display them.

Constructing of the first worksheet

At the first stage you need to run Excel and deploy a work window so that it fills the whole screen. Then, expand clean workbook, which will be called **Book1**. If any book is open in order to open a new one, click on the **New** button of the standard toolbar. First you need to enter the headers of the row and column in a worksheet **Sheet1**.

Perform the following steps.

1. Move **A3** with the arrow keys.

2. In the **Name** field enter the address of the cell.

3. In the cell **A3**, enter the **North**. To do this, type the text and press <Enter> key. Depending on your settings, Excel either move the cursor to the cell **A4**, or leave it in the cell **A3**.

4. Move the table cursor into the cell **A4**, enter the **South** and press <Enter> key.

5. In the cell **A5**, type **Total** and press <Enter> key.

6. Move the table cursor into the cell **B2,** enter the **1st quarter** and press <Enter> key.

Three other titles could be entered manually, but let's make Excel work.

7. Notice the small box in the lower right corner of the table cursor. It is called the ***fill handle***. If you place the mouse pointer on the marker, it will take the shape of a black cross.

8. Place the mouse pointer over the fill handle so that the pointer turns into a cross. Then click and drag the pointer to the right until you have identified three cells on the right side (**C2**, **D2** and **E2**). Release the mouse button and you will see that the program automatically enters instead of you three headers. This is an example of using the **AutoComplete**.

As a result, you should get a table, such as in Fig. 1.5.

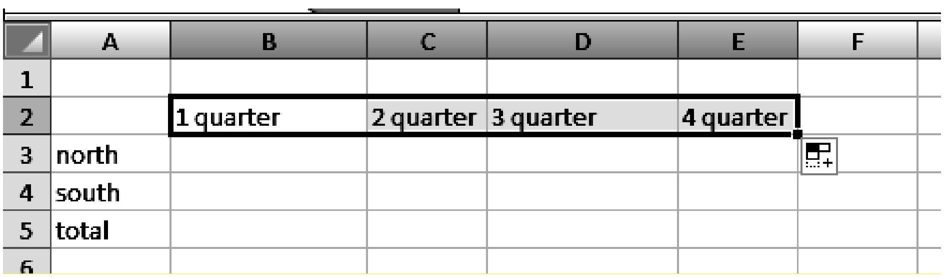


Fig. 1.5. **Worksheet after entering the headers**

Data entering

At this stage, you need to enter sales volumes per quarter for each region.

1. Move the tables cursor into the cell B3, type number 123 and press <Enter> key.

2. Move the table cursor into to the other tables cells and enter the following data.

The worksheet will look as in Fig. 1.6.

	A	B	C	D	E	F
1						
2		1 quarter	2 quarter	3 quarter	4 quarter	
3	north	123	411	456	357	
4	south	101	258	951	105	
5	total sum					
6						

Fig. 1.6. **Worksheet with entered data on sales volumes**

Creating a formula

Let's now create the formula for calculating the total sum by the regions. To do this, follow the instructions below.

1. Move the table cursor into the cell **B5**.

2. Find in the Standard toolbar, located below the menu bar, **AutoSum** button and click it. This button depicts the Greek letter "sigma". The program has placed into the cell **B5** the following: = **SUM(B3:B4)**. This is the a formula that calculates the sum of the values of the cells that are in the range **B3:B4**.

3. Press <Enter> key to enter the formula. You will see that in the cell **B5** the sum of two numbers appears. You could repeat the same operation for the three quarters remaining, but it is much easier to copy the formula into three cells, located on the right side.

4. Move the table cursor into the cell **B5**.

5. Place the mouse pointer over the fill handle. When it turns into a cross, click and drag the pointer three cells to the right. When you release the mouse button, you will see that Excel copied the formula into selected cell. When data changes, these formulas are recalculated automatically and the new results are displayed.

Formatting a table

The table you have created can look better. At this stage one can take an opportunity of the Excel automatical formatting. Perform the following steps.

1. Place the table cursor into any cell.

2. Select the command **Format** > **AutoFormat**. The result will be the following: Excel will determine the boundaries of the table and highlight all of it, and will open the **Auto Format** dialog box.

3. The **Auto Format** dialog box offers 16 ready formats to choose. Click on the format you like.

4. Click on the button **OK.**

Your table should look like in Fig. 1.7.

Adding a title heading

At this stage, we introduce the table header, select it in bold and place in the center relative to the table columns. For this purpose do the following.

1. Place the table cursor into the cell **A1**.

2. Enter **The volume of sales by regions** and press <Enter> key.

3. Move the cursor back to the table cell **A1**, if it was in a different cell, and click the **Bold key**, located on the formatting toolbar. This button depicts the capital large letter **B**.

4. Click on the button drop-down **Size**, which is located on the formatting toolbar. Choose from the list number 14.

5. Click on the cell **A1** and drag mouse pointer to the right to select the cells **A1, B1, C1, D1** and **E1** (i.e. range **A1:E1**). Just don't drag the fill handle. You need to select the cell, and not to copy the cell **A1**.

6. Click on the button **Merge and Center**, located on the formatting toolbar. As a result, the text that is in the cell **A1**, will be centered relative to the selected cells.

Now your worksheet should look as in Fig. 1.7.

	A	B	C	D	E	F
1		**Volume of sales by region**				
2		1 quarter	2 quarter	3 quarter	4 quarter	
3	north	123	411	456	357	
4	south	101	258	951	105	
5	total sum	224	669	1407	462	
6						

Fig. 1.7. **Formatted table with the header**

Saving a workbook

All you have done so far has been stored in your computer RAM. And if suddenly lost power, all will be lost. So it's time to save the results of the work done in the file. Name it, for example, **My first workbook**.

1. It depicts a diskette. Excel will open the dialog box **Saving document**.

2. Click on the **Save** button on the standard toolbar.

3. In the **File Name** enter **My first workbook**, and click on the **Save** button or press <Enter>.

The program will save the workbook in a file. Thus workbook is left open, and you can continue using it.

Laboratory work No. 2
Submission of statistical data: graphs

The purpose of the work is to acquire the skills of analysis of statistical data using the graphical method in the package MS Excel.

Its tasks are to construct the graphs on the basis of statistical data, see the types of the graphs in MS Excel, get acquainted with the "Chart Wizard" possibilities.

Guidelines

Building a chart by pressing a keyboard single key.

The following sequence of actions gives the opportunity to create a chart on a separate sheet.

1. Entering the input data, which will be used to create a chart (Fig. 2.1).

	A	B	C
1		Enterprise 1	Enterprise 2
2	January	1 843	982
3	February	2 283	1 092
4	March	2 183	1 143

Fig. 2.1. **Input data**

2. Select the range of data, including row and column headers. For example, if the chart is based on the data presented in Fig. 2.1, you need to highlight the range A1:C4.

3. Press the key F11. Excel will build basing on a selected range a chart and put it on a new chart sheet with the name of chart 1. In Fig. 2.2 the result of this procedure is shown.

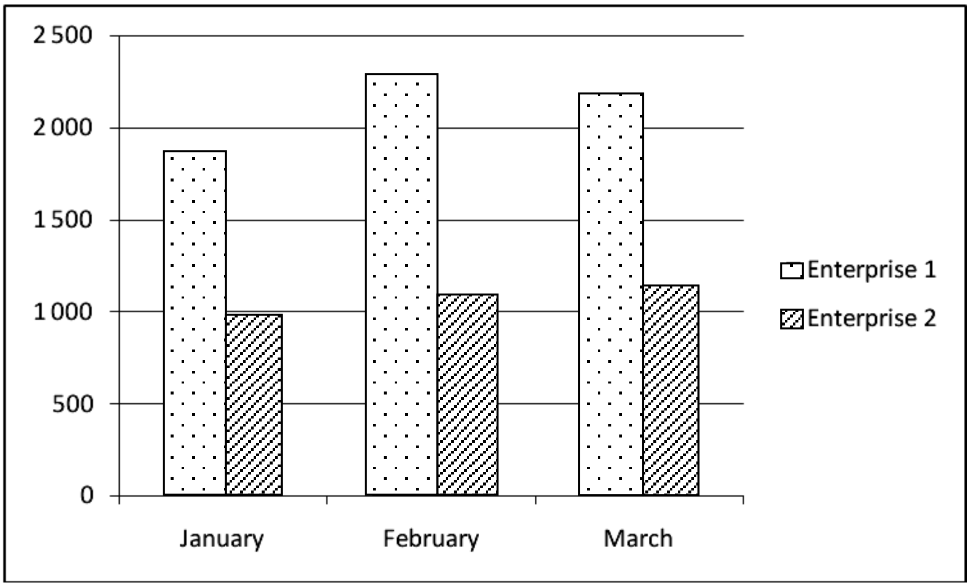


Fig. 2.2. **The chart built by one click of keyboard button**

Building a chart by pressing a single button mouse

The approach implies the implementation of such actions:

1. Make sure that the *Charts* toolbar is on the screen.

2. Select the data basing on which chart 1 will be created.

3. Press the *Chart type* button, which is located on the *Charts* toolbar, and select the type of a chart (Fig. 2.3).

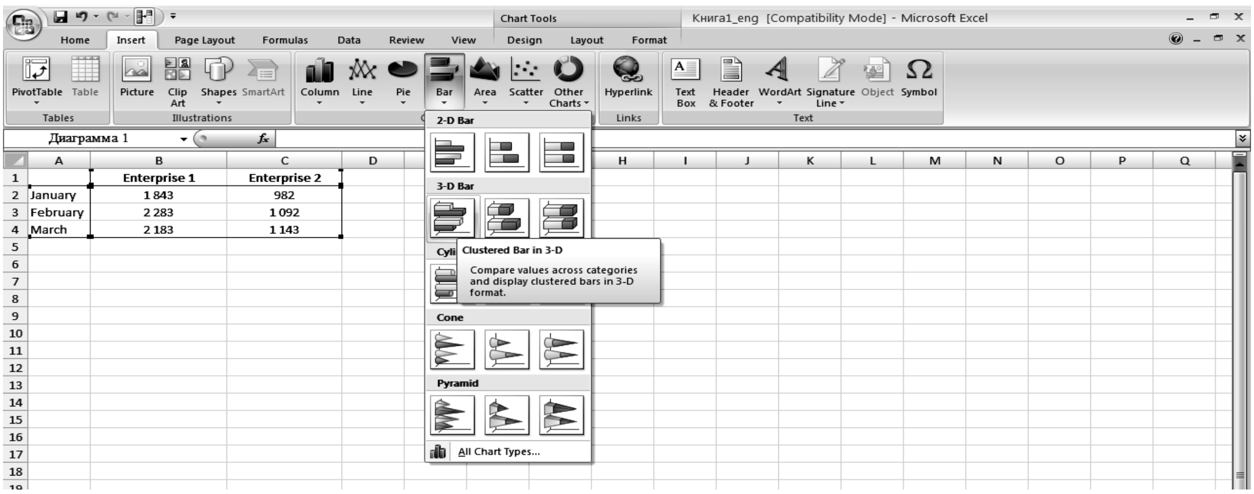


Fig. 2.3. **Building a chart by clicking a single mouse button**

Using the *Chart Wizard* function*.* In practice, it often happens that it is necessary to specify certain chart settings. In this case, you need to make changes to the settings manually after creating a chart. But for more control it is better to use the *Chart Wizard*, which provides for the implementation of such a sequence of actions.

Selecting Data. After entering the input data, highlight indicators for the construction of the chart to simplify the work (Fig. 2.4). Otherwise, you can choose them in the second *Wizard* dialog box.

In this example (Fig. 2.4) the range A3:E9 was selected. This range contains the column headers, but it doesn't include the name of a chart, which is stored in the cell A1.

	A	B	C	D	E
1	Level of education regular readers of periodical editions				
2					
3	Year	Without secondary education	Secondary education	Higher education	Academic degree
4	2000	53%	55%	71%	70%
5	2002	47%	56%	59%	70%
6	2004	42%	48%	55%	60%
7	2006	41%	44%	53%	59%
8	2008	36%	40%	48%	57%
9	2010	23%	43%	48%	58%

Fig. 2.4. **Initial data**

Starting the Chart Wizard. To do this, click on the *Chart Wizard* pictogram, which is located on the toolbar, or choose *Insert – Chart*. You will see the first of the four *Chart Wizard* dialog boxes on the screen.

You can always go back to the previous stage of the work, pressing the *Back* button, and the next one – the *Next button*. To immediately complete the construction of a chart, click *Finish*.

Chart Wizard: Step 1 of 4. Fig. 2.5 presents the first *Wizard* window, where the type of a chart is determined. The dialog box contains two tabs – *Standard* and *Custom*. The *Standard* tab includes 14 basic chart types with relevant subtypes, and the *Custom* tab contains some special types of charts, including the manufacturer's.

For this example, it is expedient to choose a chart type *Chart with markers*. From the list *Type* select the element *Graph*, then click the icon graph of a suitable type (subtype) in the list *View*.

After determining the *Type* and *View* (subtype) charts, click on the *Next* button to proceed to the next step.

Chart Wizard: step 2 of 4. At the second step of the Chart Wizard function (Fig. 2.6) you can define such parameters:

check out the range of input data, if you want to change it;

determine the orientation of the data (rows or columns);

verify whether Excel divided the categories source data and ranks correctly.

Checking a range of input data. At the second step dialog box Chart Wizard contains two tabs: Data Range and the *Range of Row data* ones.

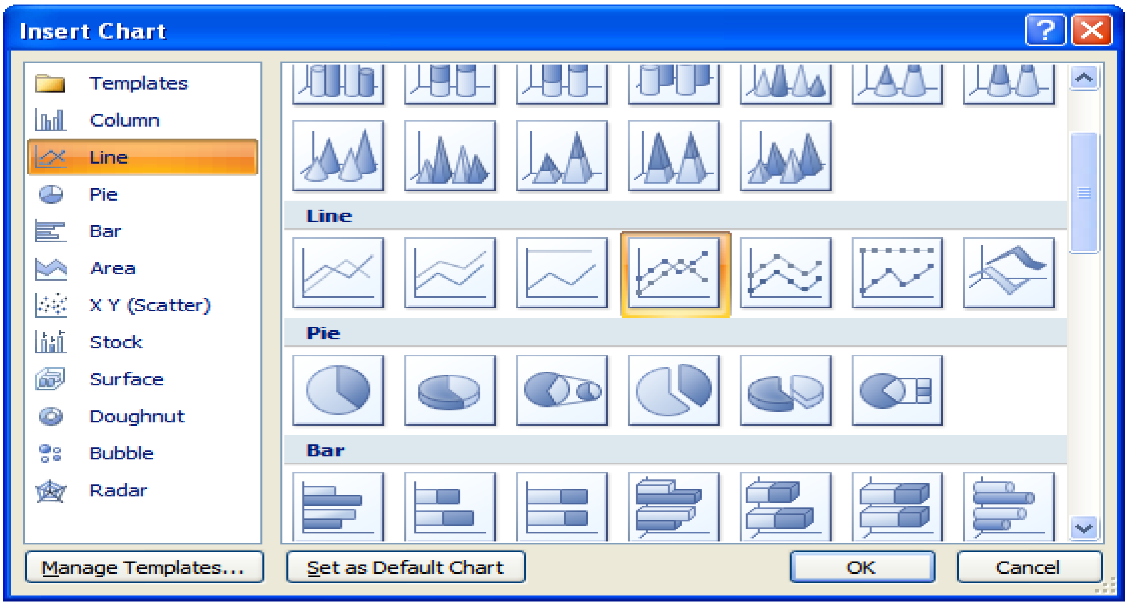


Fig. 2.5. **The first window Chart Wizard: Chart Type**

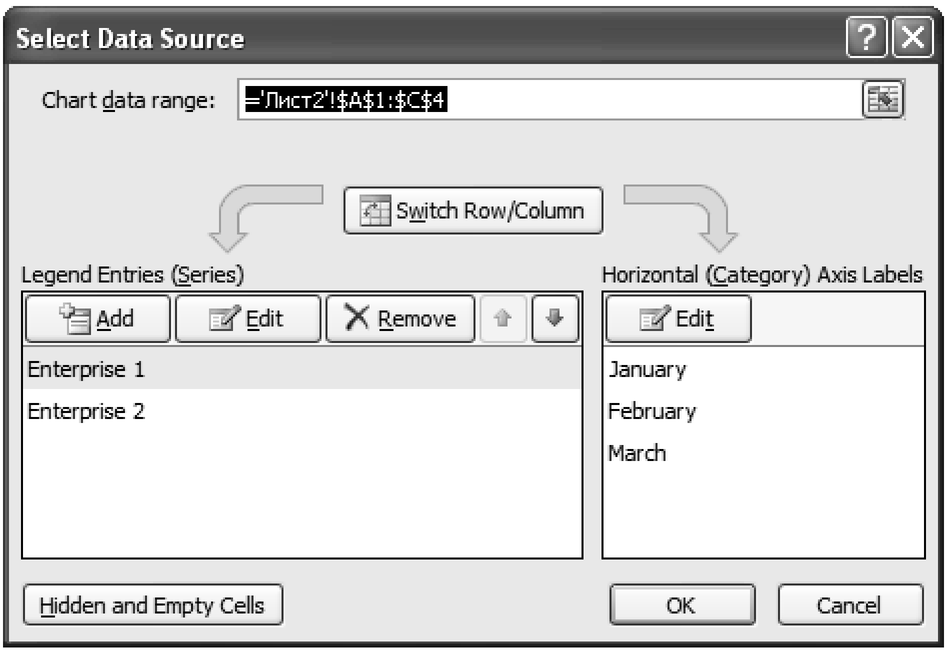


Fig. 2.6. **The second window of the Chart Wizard: data range tab**

Range field contains a reference to a range that has been allocated before starting the *Chart Wizard* tool. If you have selected only one cell, Excel will show a link to the foreseen range of input data.

If the data range isn't defined properly, it can be changed. To do this, press the *Range* field and highlight the data necessary on the worksheet.

Change the orientation of the data. Data orientation cardinally affects the appearance of a chart. Excel itself performs this procedure. In case of automatic execution of Excel, this option is not implemented correctly, the orientation can be set manually by selecting the desired position for *Series* switch.

Delimiting the data categories and series. When Excel mistakenly identified the *Year* in both columns A series of data, and in fact, the number of the year is the name of the category and should be treated as text and does not appear in the chart as a numeric value, they must be set manually. To do this, go to the Series tab (Fig. 2.7).

The Series list contains the names of all the series data of the chart. In Fig. 2.7 the name of *Year* series is in the cell A3, and value – in the range of A4:A9.

As a *Year* series is not really a series, and contains the name of the X-axis, then it must be removed from this list. To do this, highlight the necessary series and press the *Delete* button. As a result of the appearance of chart will change and will not have a signature on the category axis.

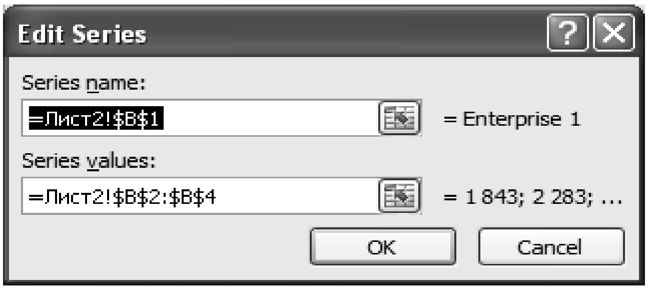


Fig. 2.7. **The second window of the Chart Wizard: Series tab**

Signatures of the X axis field is empty, so you must specify a range that contains these signatures. To add a signature, click on the field and select the A4:A9 range. After that the years are displayed as categories on the horizontal axis, and the chart itself consists of four rows of data (Fig. 2.8).

Fig. 2.8. **Tab after removal of one row and adding the X-axis Labels**

Chart Wizard: step 3 of 4. In the third dialog box the Chart Wizard set most of the options that define the appearance of a chart (Fig. 2.9). The options depend on the type of a chart. The dialog box contains six tabs.

Headlines. Adding Chart Titles.

Axis. Displaying and deleting the axis, as well delimiting their types.

Grid lines. Defining the grid settings if it is in the chart.

Legend. Determining the presence and location of a legend.

Data labels. Determining the presence and place name data.

Table of data. Determining the presence of the data table.

Fig. 2.9 displays the change of only two parameters in the *Titles* tab. In the *Chart the Level of education of regular readers of the periodicals*, and in the X-*axis (of categories) – the Year were entered.*

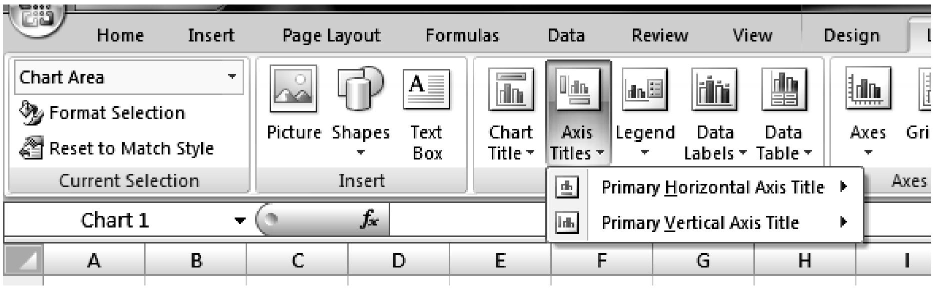


Fig. 2.9. **The third window of the Chart Wizard: options that determine the appearance of the chart**

***Chart Wizard: step 4 of 4*.** In the last dialog box it should be indicated where to place the chart. The switch is set to *Private* if you want to place the chart on a separate sheet, or if the position is *Available*, to create an introduced chart (Fig. 2.10). Click Finish*.*

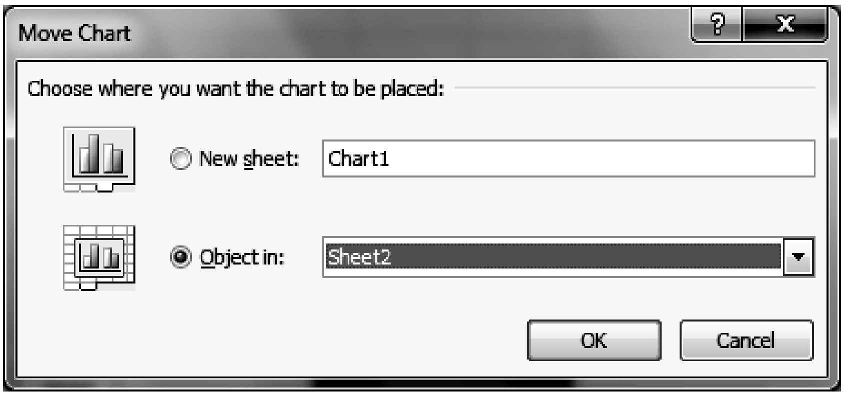


Fig. 2.10. **The fourth window of the Chart Wizard: the location of the chart is specified**

If you created a nested chart, Excel will place it in the centre of the active window (Fig. 2.11).

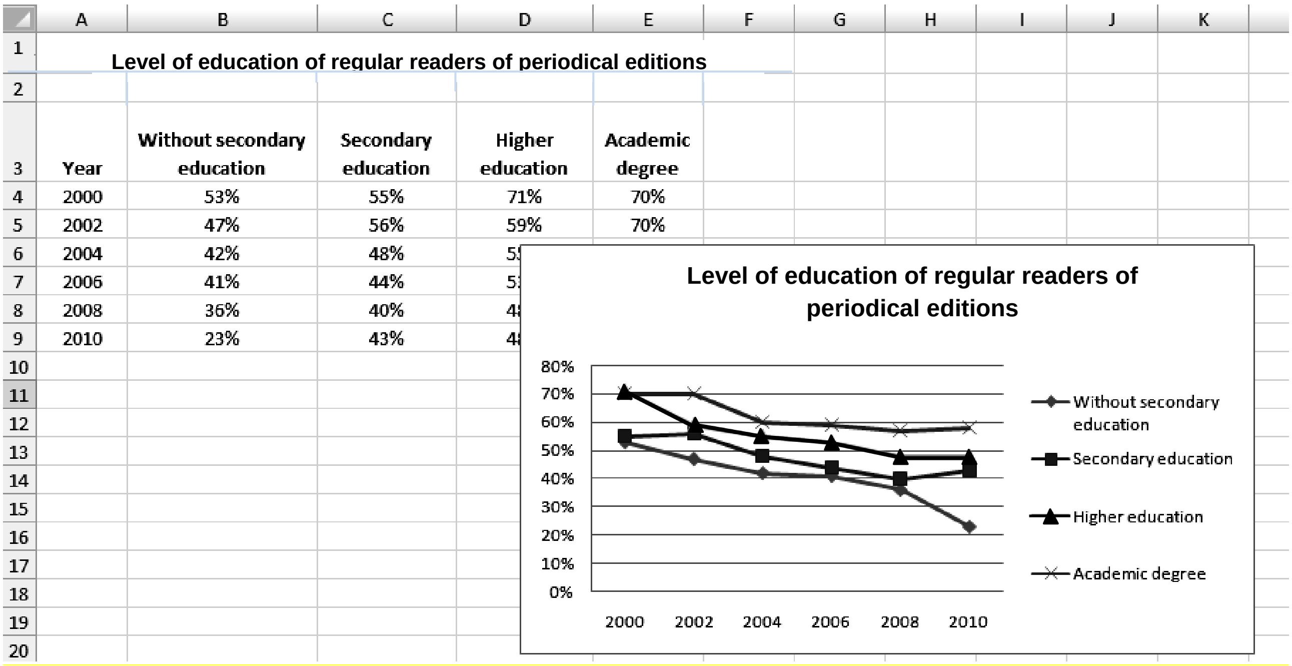


Fig. 2.11. **The chart constructed by means of Chart Wizard tool based on the specified parameters**

Changing the settings of the chart (elements). The chart constructed can be modified any time. But before starting to modify the chart (any item), it is necessary to activate it by clicking on a chart (or element).

The most frequently used settings of charts are:

moving and resizing a chart (nested) in order to move the chart one must click on its border, and then drag. To change the size of the chart you need to drag one of eight size markers on the border of the chart;

changing the type of a chart. The first method involves pressing the *Chart Type* button, which is located on the tool bar *Charts* (see Fig. 2.3) and the choice of one of the 18 main types of charts. The second way is to right-click on the chart and choose from the shortcut menu *Chart Type*;

moving and deleting chart elements. Some elements of the chart can be moved (for example, titles, legend, or data table). To move a chart element, select it by clicking with the mouse, then drag it to the right place of the chart. To delete a chart element you need to select it, and then press *Delete*;

formatting the chart and its elements. Activation of a chart (chart element) allows to change parameters. The first method involves the use of commands from the context menu. The second one assumes the use of *Charts* toolbar commands (see Fig. 2.3), and the third one is the use of a set of commands that are on the other toolbars (such as *Fill colour* data series, *Bold* chart legends, etc.).

Laboratory work No. 3
Summarization and grouping of statistical data

The purpose of the work is to acquire the skills of grouping data into MS Excel.

Its task is to group statistical data using the "Data Analysis" add-in of MS Excel.

Guidelines

Summarization and grouping of statistical data should be performed by the mode "Histogram", "Data Analysis" add-in.

The mode "Histogram" is used to calculate the frequency of contact data in the specified boundaries of intervals, and to build the histogram of interval variation distribution range.

The dialog box of this regime (Fig. 3.1) assumes the following parameters:

1. Input range, i.e. the location of the input data on your worksheet.

2. Bin range (optional parameter), i.e. entering a link to the cells containing a set of limits that define the intervals (pocket). These values must be entered in ascending order. In Microsoft Excel the number pointing the intervals by the data is calculated. The limits of intervals have strict lower limit and not strict upper limit.

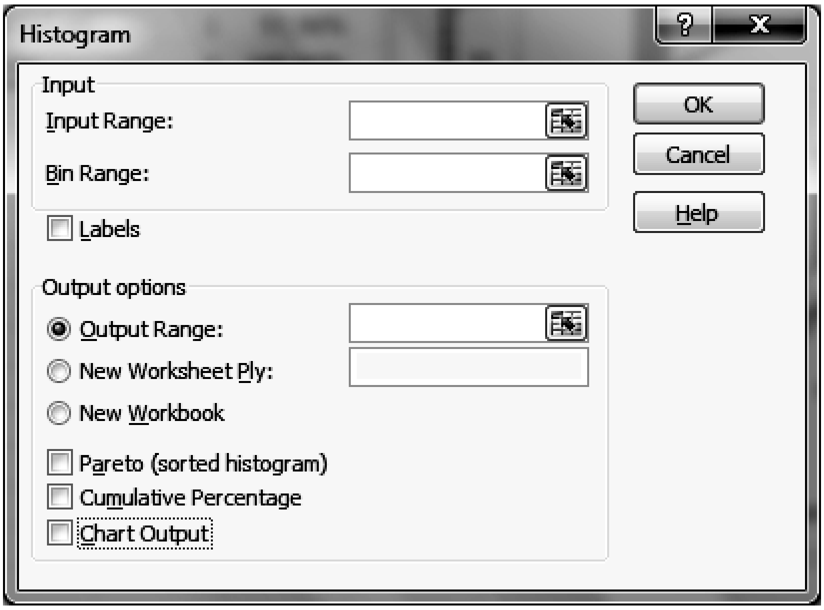


Fig. 3.1. **"Histogram" window**

If the bin range was not entered, then a set of intervals, evenly distributed between the minimum and maximum values of the data will be generated automatically.

3. Labels, which are set in an active state, if the first row (column) in the input range contains titles. If no titles, checkbox should be deactivated. In this case, standard names for the output range will be automatically created.

4. Output range / New Worksheet / New Workbook activates the field where the link to the upper-left cell of the output range should be entered. The output range is automatically detected and a message appears in case of the possible imposition of the original range to the output range.

5. Pareto (sorted histogram) is set in an active state to represent the data in descending order of frequency. If it is unchecked, the data in the output range will be listed in order of intervals.

6. Cumulative percentage is set in an active state to calculate the percentage of accumulated frequencies and inclusion of the graph of accumulated frequencies in the histogram.

7. Chart Output is set in the active state for automatic building of an embedded chart on a worksheet containing the input range.

Example. The GDP volume per capita (current USD) in 2011 is shown in Table 3.1.

Enter input data into the cells A1:B50.

You need to construct a histogram and accumulated frequencies in the histogram. In order to solve the task the "Histogram" mode could be used. The parameters in the dialog "Histogram" are shown in Fig. 3.2.

Table 3.1

Input data

Country name	2011	Country name	2011
1	2	3	4
Albania	4,029.73	Latvia	12,726.4
Armenia	3,305.49	Lithuania	13,339.2
Austria	49,707.1	Luxembourg	115,038
Azerbaijan	6,915.76	Macedonia, FYR	4,925.34
Belarus	5,820.35	Moldova	1,966.93
Belgium	46,469.2	Montenegro	7,197.13
Bosnia and Herzegovina	4,820.67	Netherlands	50,087.3
Bulgaria	7,158.12	Norway	98,102.5
Croatia	14,488.3	Poland	13,462.9

Table 3.1 (the end)

1	2	3	4
Cyprus	30,670.3	Portugal	22,329.8
Czech Republic	20,407.3	Romania	8,405.49
Denmark	59,683.8	Russian Federation	13,089.3
Estonia	16,555,8	Serbia	6,203.47
Finland	49,391.3	Slovak Republic	17,646
France	42,377.4	Slovenia	24,141.9
Georgia	3,202.53	Spain	32,244.2
Germany	43,689.3	Sweden	56,927
Greece	26,427.2	Switzerland	80,390.8
Hungary	14,043.7	Tajikistan	934.82
Iceland	44,072.3	Turkey	10,498.3
Ireland	48,423.2	Turkmenistan	4,721.96
Italy	36,115.7	Ukraine	3,615.38
Kazakhstan	11,244.9	United Kingdom	38,817.8
Kosovo	3,592.6	Uzbekistan	1,545.93
Kirgiz Republic	1,074.74		

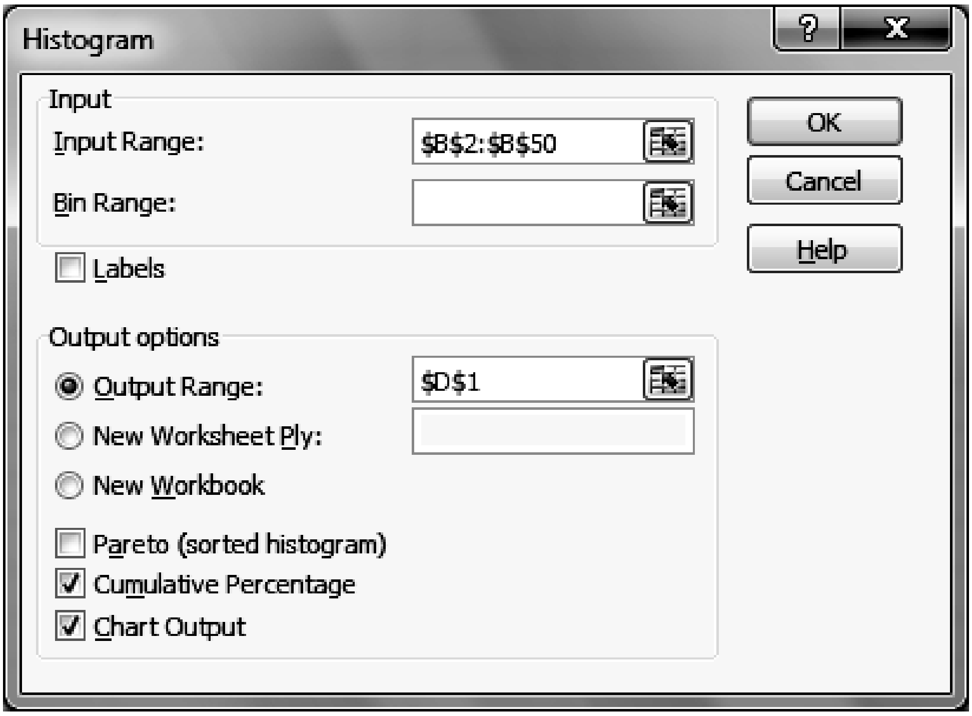


Fig 3.2. **Filling the "Histogram" window**

The frequencies and cumulative frequencies are presented in Table 3.2.

Table 3.2

The frequencies and cumulative frequencies

Bin	Frequency	Cumulative %
934.8201	1	2.04 %
17,235.26	26	55.10 %
33,535.69	7	69.39 %
49,836.13	9	87.76 %
66,136.57	3	93.88 %
82,437	1	95.92 %
98,737.44	1	97.96 %
More	1	100.00 %

So we see that uneven distribution of countries by the indicator "the GDP per capita": 26 countries of 49 have a value of the GDP per capita from 934.82 dollars to 17,235.26 dollars.

The histogram of constructed and accumulated frequencies is shown in Fig. 3.3.

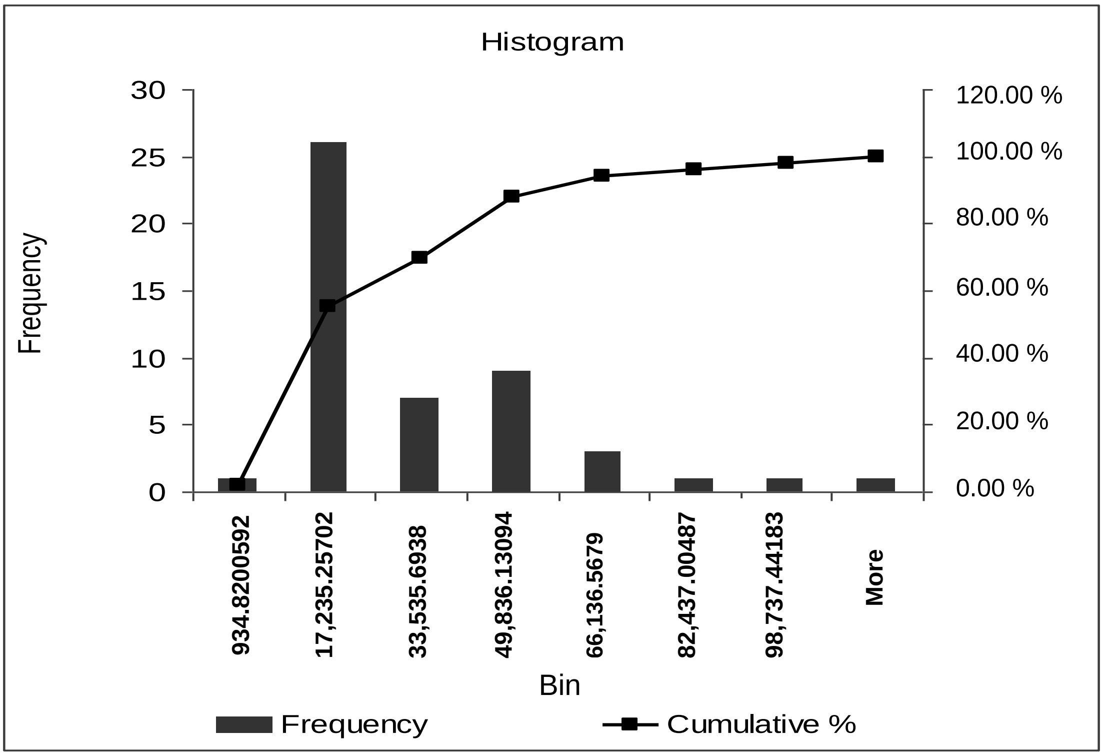


Fig. 3.3. **Histogram of distribution**

Table 3.2 "Cumulative %" explains the calculation of the accumulated frequencies. Cumulative frequency is calculated based on the frequency (see Table 3.2 "Frequency" column). Each value of cumulative frequency is divided by the maximum accumulated value. The result is relative frequency expressed in fractions of a unit. After the transformation to a percentage format the final result is obtained.

Laboratory work No. 4
Generalizing statistical indicators

The purpose of the work is to acquire the skills of calculating the averages in MS Excel.

Its task is to calculate relative and average statistical indicators by means of MS Excel.

Guidelines

Absolute values characterize the size of socioeconomic phenomena. This refers to the aggregate amount or its certain parts (a number of elements) and the corresponding values of volume attributes.

Absolute statistical indicators are of indisputable statistical significance in management, but in-depth socioeconomic analysis of the facts requires various comparisons. The values of statistics are compared in time (in relation to one object) and in space (between the objects), different signs of the same object are correlated.

The result of the comparison is the relative statistical indicator that characterizes the measure of quantitative correlation of dissimilar or similar indicators.

Each relative indicator is a fraction, the numerator of which is the comparable value, and the denominator is the base of comparison. A relative indicator shows how many times the comparable value exceeds the baseline or the proportion of the base of comparison. Formulas for calculating the statistical indicators are given in Table 4.1.

Table 4.1

Formulas of calculation of statistical indicators

Name of indicator	Formulas of calculation
Relative indicator of dynamics	$RID = \frac{y_1}{y_0}$
Relative indicator of plan performance	$RIPP = \frac{y_1}{y_{pl}}$
Relative indicator of a planned target	$RIPT = \frac{y_{pl}}{y_0}$
Arithmetic average value	Simple: $\bar{x} = \frac{\text{Volume of an attribute value}}{\text{Volume of a set}} = \frac{\sum_1^n x}{n}$. Weighed: $\bar{x} = \frac{\sum_1^m x_j f_j}{\sum_1^m f_j}$.
Harmonic average value	Simple: $\bar{x} = \frac{n}{\sum_1^n \frac{1}{x}}$. Weighed: $\bar{x} = \frac{\sum_1^m M_j}{\sum_1^m \frac{1}{x} M_j}$.
Geometric average value	Simple: $\bar{x} = \sqrt[n]{x_1 \times x_2 \times x_3 \times \ldots \times x_n} = \sqrt[n]{\prod_1^n x_i}$. Weighed: $\bar{x} = \sqrt[n]{\prod_1^m x_j^{n_j}}$

Let's consider the example of calculation of relative indicators by means of MS Excel.

Task 1

We have data on the sales of industry products, thousands (Table 4.2).

Table 4.2

Input data

Enterprise number	Sales in the 1st quarter	Plan for the 2nd quarter	Sales in the 2nd quarter
1	8,500	8,650	8,720
2	7,540	7,650	7,700
3	9,900	10,400	10,670
4	5,900	6,000	5,950

Calculate the percentage of statistic indicators that characterize the planned target, performance of the plan and the dynamics of sales for each enterprise and for the union as a whole. Make a conclusion.

Relative indicator of a planned target is calculated as the ratio of the planned sign in the current period to the actual characteristics of the previous period. Calculation formulas in the program Excel (Fig. 4.1) begins with the sign "=" in the row. To begin with one highlight the value should be in the numerator (C2), put a division mark and select the values which should be in the denominator (B2), then multiply the fraction by 100 (C2/B2 × 100), press Enter in order to obtain numerical results. The indicators of other enterprises are calculated in the similar way or you can select the result and expand it up to the column.

A	B	C	D	E
Enterprise number	Sales in the 1st quarter	Plan for the 2nd quarter	Sales in the 2nd quarter	Relative indicator of a planned target
1	8 500,00	8 650,00	8 720,00	=C2/B2*100
2	7 540,00	7 650,00	7 700,00	101,46
3	9 900,00	10 400,00	10 670,00	105,05
4	5 900,00	6 000,00	5 950,00	101,69

Fig. 4.1. **The calculation of the relative indicator of a planned target**

The calculation of a relative indicator of performance of a plan and the relative indicator of the dynamics are similar to the calculation of the relative indicator of a planned target (Fig. 4.2 and 4.3). The numerator and denominator of these variables are relevant indicators which are used for their calculation (see formula).

	A	B	C	D	E	F
1	Enterprise number	Sales in the 1st quarter	Plan for the 2nd quarter	Sales in the 2nd quarter	Relative indicator of a planned target	Relative indicator of a plan performance
2	1	8 500,00	8 650,00	8 720,00	101,76	=D2/C2*100
3	2	7 540,00	7 650,00	7 700,00	101,46	100,65
4	3	9 900,00	10 400,00	10 670,00	105,05	102,60
5	4	5 900,00	6 000,00	5 950,00	101,69	99,17

Fig. 4.2. **The calculation of the relative indicator of a plan performance**

In order to determine these indicators for the association as a whole we need to calculate the sum of input data (in columns) by using AutoSum (Σ) on the toolbar Excel (Fig. 4.4). The calculation of relative indicators of the planned target, performance of the plan and the dynamics for the association are calculated similar to the calculation of indicators for each company by the ratio of two values (Fig. 4.5).

	A	B	C	D	E	F	G
1	Enterprise number	Sales in the 1st quarter	Plan for the 2nd quarter	Sales in the 2nd quarter	Indicator of a planned target	Indicator of a plan performance	Indicator of the dynamics
2	1	8 500,00	8 650,00	8 720,00	101,76	100,81	=D2/B2*100
3	2	7 540,00	7 650,00	7 700,00	101,46	100,65	102,12
4	3	9 900,00	10 400,00	10 670,00	105,05	102,60	107,78
5	4	5 900,00	6 000,00	5 950,00	101,69	99,17	100,85

Fig. 4.3. **The calculation of the relative indicator of the dynamics**

	A	B	C	D
1	Enterprise number	Sales in the 1st quarter	Plan for the 2nd quarter	Sales in the 2nd quarter
2	1	8 500,00	8 650,00	8 720,00
3	2	7 540,00	7 650,00	7 700,00
4	3	9 900,00	10 400,00	10 670,00
5	4	5 900,00	6 000,00	5 950,00
6	Total	=СУММ(B2:B5)	32 700,00	33 040,00

Fig. 4.4. **AutoSum**

	A	B	C	D	E
1	Enterprise number	Sales in the 1st quarter	Plan for the 2nd quarter	Sales in the 2nd quarter	Indicator of a planned target
2	1	8 500,00	8 650,00	8 720,00	101,76
3	2	7 540,00	7 650,00	7 700,00	101,46
4	3	9 900,00	10 400,00	10 670,00	105,05
5	4	5 900,00	6 000,00	5 950,00	101,69
6	Total	31 840,00	32 700,00	33 040,00	=C6/B6*100

Fig. 4.5. **The calculation of indicators for the association**

The relative indicator of a planned target characterizes the plan change in the current period compared to the actual value of the previous period. It can be concluded by the first company – in the current period the company planned to realize production that is by 1.76 % more than actually realized in the first quarter. For the association it is planned to realize production that is by 2.7 % more than in the previous period.

Relative indicator of the plan performance shows the percentage of actual value changes compared to the plan. In the second quarter the second company sold products by 0.65 % more than it was planned. Industrial enterprises sold products by 1.04 % more than it was planned.

Relative indicator of the dynamics determines the dynamics of the changes of socioeconomic phenomenon in time. It can be concluded that in the second quarter all the enterprises sold products by 3.77 % more than in the first one.

Task 2

Consider the combination of using the relative indicators of the dynamics, structure and coordination (Table 4.3).

Table 4.3

Material reserves of the company

Material reserves	Reserves, thousand UAH, at the end of the quarter		The IV quarter, % the III quarter	Structure of reserves, % to the end of the quarter		Structural shifts, p.p.
	III	IV		III	IV	
Raw materials	119	122.5	102.5	68	62	–6
Finished product	56	74	132.1	32	38	+6
Total	175	196	112.0	100	100	0

Relative indicators of the structure are calculated as the ratio of the share to the whole, that is the row line "Raw materials" (B3) is divided by the row line "Total" (B5) and multiplied by 100 % (Fig. 4.6). Sign "$" in denominator fixes the cell if then you shift formula.

Structural changes are calculated as the difference between the structure of reserves in the fourth and the third quarters.

	A	B	C	D	E	F	G
1	Material reserves	Reserves, thousand UAH, at the end of the quarter		The IV quarter, % to the III quarter	Structure of reserves, % to the end of the quarter		Structural shifts, p.p.
2		III	IV		III	IV	
3	Raw materials	119	122,5	102,5	=B3/$B$5*100	70	
4	Finished product	56	74	132,1	32	42,285714	
5	Total	175	196	112	100	112	

Fig. 4.6. **The calculation of the relative indicator of the structure**

In the fourth quarter reserves generally increased 1.12 times, i.e. by 12 % (Fig. 4.7). As reserves consist of two functionally distinct components, it is necessary to assess the dynamics of each of them. So, raw materials increased only by 2.5 %, while reserves of finished product – by 32.1 %. Irregularity of dynamics of individual components has led to changes in the structure of reserves. In the third quarter the share of raw materials was 68 %, in the fourth quarter it decreased to 62 %, that is by 6 percentage points. Due to structural changes the proportions between the constituent parts have changed: in the third quarter for 1 UAH of reserves of finished products 2.125 USD of raw materials reserves (119 : 56 = 2.125) were accounted, in the fourth quarter it decreased to 1.65 (122 : 74 = 1.65).

	A	B	C	D	E	F	G
1	Material reserves	Reserves, thousand UAH, at the end of the quarter		The IV quarter, % to the III quarter	Structure of reserves, % to the end of the quarter		Structural shifts, p.p.
2		III	IV		III	IV	
3	Raw materials	119	122,5	102,5	68	70	=F3-E3
4	Finished product	56	74	132,1	32	42,285714	
5	Total	175	196	112	100	112	

Fig. 4.7. **The calculation of structural changes**

As most of the socioeconomic phenomena are characterized by additivity of volumes (sugar, fuel, etc.), so the arithmetic average is the most common one. It is calculated by dividing the total value signs by the volume set. Simple arithmetic average is calculated for primary ungrouped data.

Task 3

For example, insurance company paid insurance benefits for five damaged objects, thousand UAH: 18, 27, 22, 30, 23. Enter the data into the cells B2 and F2.

In order to calculate the average payment of insurance one should put in Excel sign B2 "=" into the cell and select "function" (f) on the formula bar. The possibilities of this module are presented in the window (Fig. 4.8).

In order to calculate the average value one should select the AVERAGE function, (B3:F3) and in the dialog "Function Arguments" (Fig. 4.9), click "OK" (Fig. 4.10).

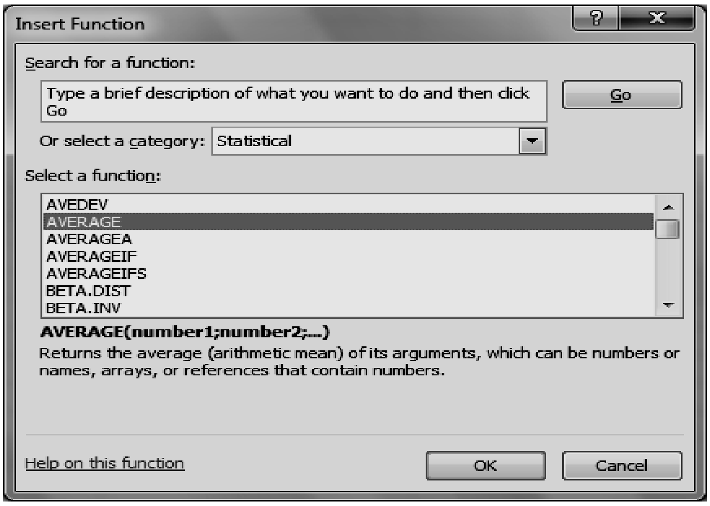


Fig. 4.8. **Dialog window** "**Wizard Functions**"

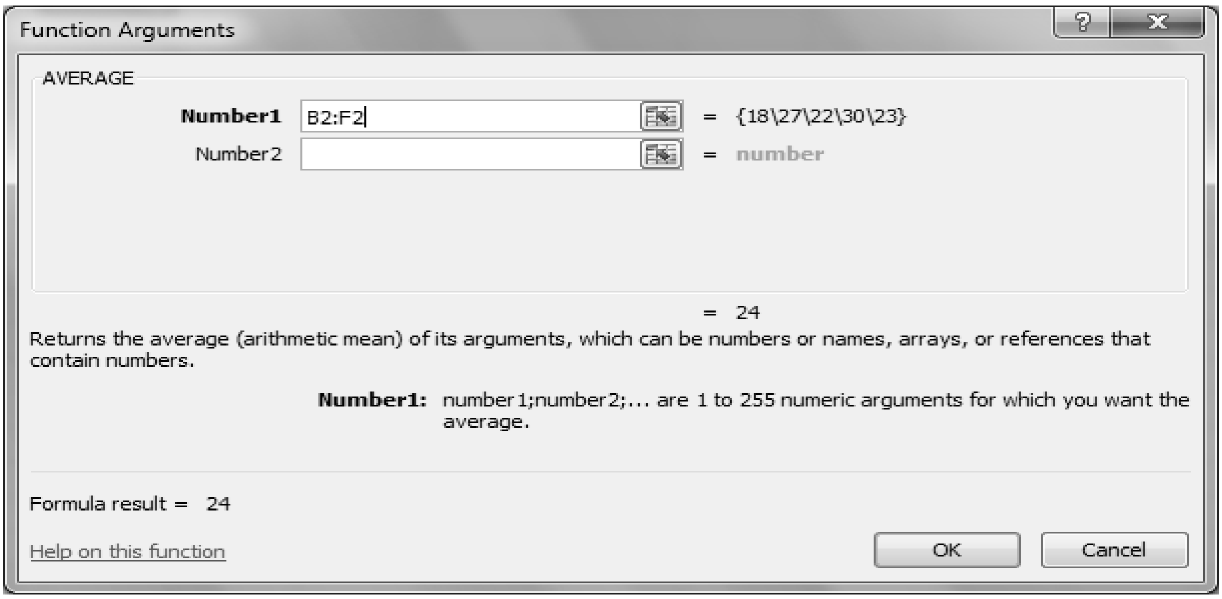


Fig. 4.9. **Dialog window** "**Function Arguments**"

	A	B	C	D	E	F
1	Damaged objects	1	2	3	4	5
2	Insurance benefits, thousand UAH	18	27	22	30	23
3	Average payment	24				

Fig. 4.10. **The result of the calculation of the average insurance payment**

On the average, the insurance company paid insurance benefits for five damaged objects to the amount of 24 thousand UAH.

Task 4

We have data concerning two companies that produce the same productions, (Table 4.4).

Table 4.4

Input data

Company	2011		2012	
	Time expenditure per unit, hours	Produced units	Time expenditure per unit, hours	Time expenditure on all products, hours
A	2.0	150	1.9	380
B	3.0	250	3.05	840

Determine the average time expenditure per unit by two companies in 2011 – 2012.

To determine the average time expenditure in 2011 use a formula of arithmetic weighted average, because we have an attribute value (time expenditure per unit is "x") and the frequency of its appearance (produced units are "f"). Enter the formula =B3×C3 into the cell F3 and expand this formula to the whole column. In the cell F5 calculate the sum of a column: press sign AutoSum "Σ" on the toolbar or press "=" and choose the SUM formula in the formula bar. Calculate the sum in the cell C5 (Fig. 4.11).

	A	B	C	D	E	F
1	Company	2011		2012		
2		Time expenditure per unit, hours	Produced units	Time expenditure per unit, hours	Time expenditure on all products, hours	x*f
3	A	2	150	1,9	380	=B3*C3
4	B	3	250	3,05	840	=B4*C4

Fig. 4.11. **The calculation of the arithmetic weighted average**

To calculate the average value enter the formula =F5/C5 into the cell G5 and press "Enter" and get the result: in 2011 the average time costs of production of companies A and B was 2.625 hours.

In order to determine the average time expenditure in 2012 we need to use the formula of a weighted harmonic average value as we have signs (time spent per unit of product is "x") and general expenses "M". Enter the formula =E3/D3 into the cell H3 and expand this formula to the whole column. Calculate the sum of a column in the cell H5: press the AutoSum Σ sign on the toolbar or press "=" and choose the SUM formula in the formula bar. Calculate sum in the cell E5.

	A	B	C	D	E	F	G	H	I
1	Company	2011		2012					
2		Time spent per unit of product, hours	Produced products units	Time spent per unit of product, hours	Time spent on all products, hours	x*f	The average time spent in 2011	M/x	The average time spent in 2012
3	A	2	150	1,9	380	=B3*C3		=E3/D3	
4	B	3	250	3,05	840	=B4*C4		=E4/D4	
5			=SUM(C3:C4)		=SUM(E3:E4)	=SUM(F3:F4)	=F5/C5	=SUM(H3:H4)	=E5/H5

Fig. 4.12. **The calculation of harmonic weighted average**

To calculate the average value enter the formula =E5/H5 into the cell I5, press "Enter" and get the result: in 2012 the average time expenditure for production of companies A and B were 2.57 hours.

Laboratory work No. 5
Analysis of distribution series

The purpose of the work is to gain the ability to analyze the **distribution series** by means of MS Excel.

Its task is to analyze the statistical distribution series with the help of "Analysis Toolpack".

Guidelines

Base formulas for calculating the characteristics of distribution series are presented in Table 5.1.

Table 5.1

Formulas for calculating the characteristics of distribution series

Mode	$M_o = x_0 + i\dfrac{(f_{Mo} - f_{Mo-1})}{(f_{Mo} - f_{Mo-1}) + (f_{Mo} - f_{Mo+1})}$
Median	$M_e = x_0 + i\dfrac{\frac{1}{2}\sum f - S_{Me-1}}{f_{Me}}$,
Variance	$\sigma^2 = \dfrac{(x_i - \bar{x}_i)^2 \times f_i}{\sum f_i}$
Standard deviation	$\sigma = \sqrt{\sigma^2}$
Coefficient of variation	$K_\sigma = \dfrac{\sigma}{\bar{x}} \times 100\%$

You can solve the tasks of distribution series analysis in Excel by means of "Analysis Toolpack" and built-in statistical functions. Let's consider the order of work in Excel.

Analysis of ungrouped statistical data. The work starts with running Excel (similar to running the other applications – using the Start menu or by means of the shortcut). The indicators are not necessarily entered into the input spreadsheet when forming the file, you can move it from Microsoft Office documents through the clipboard. Then you can transform and visualize the data (Fig. 5.1).

	A	B
1	Enterprise	Cost price of the product, UAH
2	1	499,04
3	2	518,78
4	3	495
5	4	472,96
6	5	626,96
7	6	506,12
8	7	518,52
9	8	502,93
10	9	519,97

Fig. 5.1. **Input data**

Descriptive Statistics mode is used to generate one-dimensional statistical report on basic indicators of position, scattering and asymmetry of the population which is analyzed. To move to this mode you need to enter the menu item **Data – Data Analysis** and select this mode (Fig. 5.2).

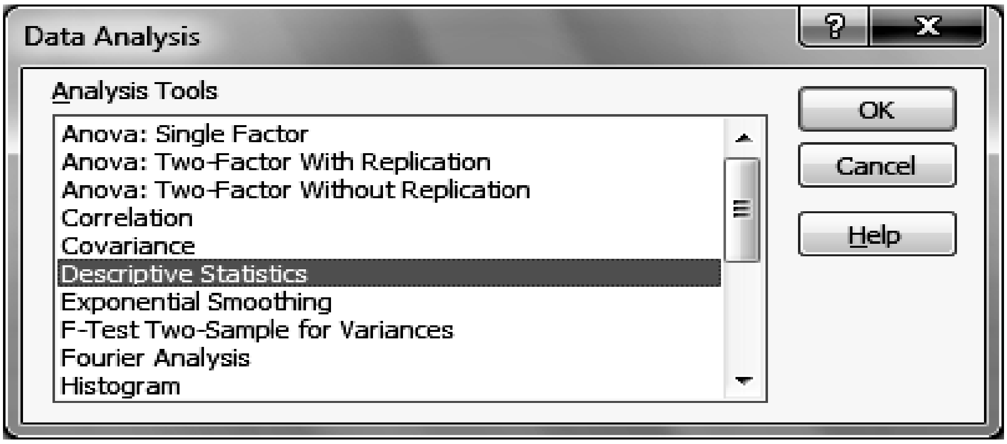


Fig. 5.2. **Selecting the Descriptive Statistics mode**

In the dialog box of this mode (Fig. 5.3) the following parameters are given:

1. **Input range**, i.e. entering the cells that contain statistical data.
2. **Grouping**, i.e. setting the position by columns or by rows, depending on the location of the data in the input range.
3. **Labels in the first row** which are activated if the first row (column) in the input range contains column labels. If you have no column labels this parameter should be deactivated. In this case standard names for the output range data will be automatically created.

4. **Output range / New Worksheet / New Workbook**.

In the **Output range** position you need to enter a link to the upper-left cell of output range in the box. The output range is automatically detected, and a message appears in the case of the possible imposition of the original range of the input data.

In the **New Worksheet** position new worksheet opens. Excel will enter the results starting with the cell A1. If you want to specify the name of the new worksheet enter the name in the box located in front of it.

In the **New Workbook** position a new workbook opens. Excel will enter the results at the cell A1 on the first worksheet.

5. **Summary Statistics** which is activated if the output range gets one field for each Descriptive Statistics indicator.

6. **Confidence level for mean** is activated if the output table includes a row for maximum sampling error at the prescribed level of reliability.

7. **K-th largest** which is activated if the row for the k-th largest (from a maximum x_{max}) value of the sample should be included in output table. If k = 1, then the row will contain the maximum value of the sample.

8. **K-th smallest** which is activated if the output table includes the row for the k-th smallest (from x_{min}) value of the sample. Enter a number *k* in the box. If k = 1, then the row will contain the minimum value of the sample.

Input parameters of *Descriptive Statistics* mode are presented in Fig. 5.3, and the calculated parameters of this mode – in Fig. 5.4.

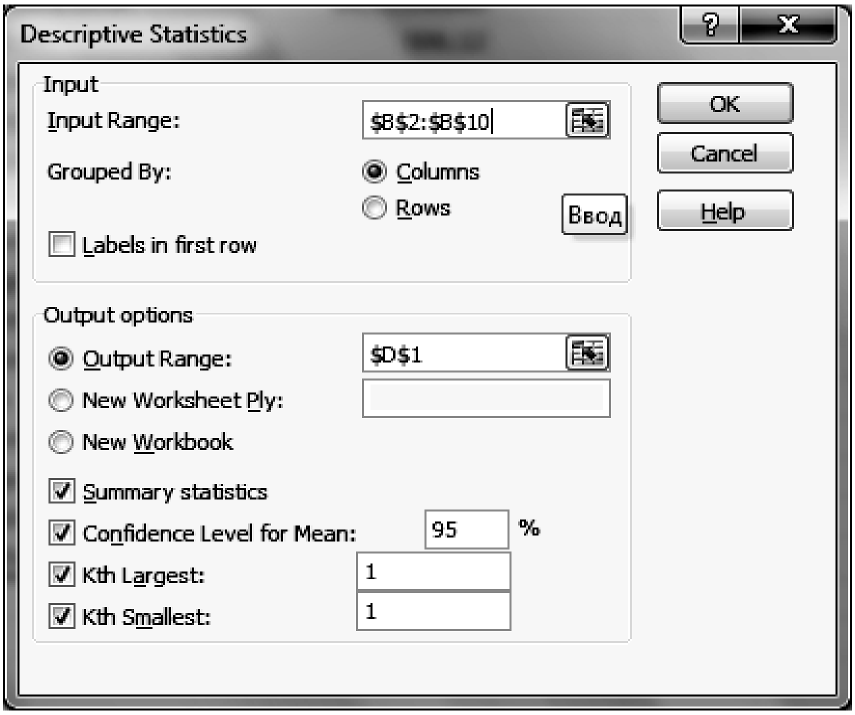


Fig. 5.3. **The parameters of *Descriptive Statistics* mode**

	A	B	C	D	E
1	Enterprise	Cost price of the product, UAH		*Column1*	
2	1	499.04			
3	2	518.78		Mean	517,8088889
4	3	495		Standard Error	14,51150649
5	4	472.96		Median	506,12
6	5	626.96		Mode	#Н/Д
7	6	506.12		Standard Deviation	43,53451948
8	7	518.52		Sample Variance	1895,254386
9	8	502.93		Kurtosis	6,349512563
10	9	519.97		Skewness	2,311803096
11				Range	154
12				Minimum	472,96
13				Maximum	626,96
14				Sum	4660,28
15				Count	9
16				Largest(1)	626,96
17				Smallest(1)	472,96
18				Confidence Level(95,0%)	33,46359398

Fig. 5.4. **The calculated parameters of Descriptive Statistics mode**

According to the data the coefficient of oscillation is calculated as follows:

$$K_R = \frac{R}{\bar{x}} \times 100\ \% = \frac{154.00}{517.81} \times 100\ \% = 29.74\ \%;$$

the coefficient of variation is:

$$K_\sigma = \frac{\sigma}{\bar{x}} \times 100\ \% = \frac{43.53}{517.81} \times 100\ \% = 8.40\ \%.$$

Analysis of grouped statistical data. After entering or moving input data from Microsoft Office documents via clipboard into a spreadsheet Excel, if necessary, you can transform and visualize the row data. In this case, you need to add a column with individual values of signs (midpoint of interval) for each group (Fig. 5.5).

The function for calculating the weighted arithmetic average is not present in Excel. But it is possible to obtain it by combination of other functions.

The cell C9 contains the formula =SUMPRODUCT(C3:C8;B3:B8)/SUM(B3:B8), by means of which the average current assets is calculated (Fig. 5.5).

	A	B	C
1	Input data		Output data
2	Current assets, m UAH	The number of enterprises	Individual values of an average sign (middle of an interval)
3	less than 5	15	4
4	5 – 7	43	6
5	7 – 9	35	8
6	9 – 11	47	10
7	11 – 13	31	12
8	more than 13	27	14

Fig. 5.5. **The calculation of the average current assets**

For the determination of mode (3) and median (4) one should make some calculations (Fig. 5.6 – 5.7).

The calculation of mode is presented in Fig. 5.6. The content of the cells (Fig. 5.6) is as follows:

the cell C9 contains the formula =MAX(B3:B8) with the help of which the modal number of companies is calculated;

the cell C10 contains the formula =MATCH(C9;B3:B8;0) by means of which the displacement of modal value is calculated in an array of B3:B8;

the cell C11 contains the formula =INDEX(A3:A8;C10;1), i.e. the modal interval of the amount of current assets in the A3:A8 array;

the cell C12 contains the formula =LEFT(C11;1) which shows the lower limit of the modal interval of the amount of current assets;

the cell C13 contains the formula =INDEX(B3:B8;C10-1;1), i.e. the number of enterprises with modal interval of current assets ($f_{M_{0-1}}$) in the B3:B8 array;

the cell C14 contains the formula =INDEX(B3: B8;C10+1;1), i.e. the number of enterprises with larger amount of current assets ($f_{M_{0+1}}$) in the B3:B8 array;

the cell C15 contains the formula =C12+2×((C9-C13)/((C9-C13)+(C9-C14))) for calculating the mode of the amount of current assets.

	A	B	C
1	Input data		Output data
2	Current assets, m UAH	The number of enterprises	Individual values of an average sign (middle of an interval)
3	less than 5	15	4
4	5 – 7	43	6
5	7 – 9	35	8
6	9 – 11	47	10
7	11 – 13	31	12
8	more than 13	27	14
9		Modal number of companies	47
10		Displacement of modal value	4
11	Modal interval of the amount of current assets		9 – 11
12	The lower limit of the modal interval		9
13		The number of enterprises	35
14		The number of enterprises	31
15	The mode of the amount of current assets		9,86

Fig. 5.6. **The calculation of the mode**

Due to the fact that the median divides the population in half, it will be where the cumulative frequency is a half or more than half of the total amount of frequencies, and the previous cumulative frequency is less than a half of the population size (Fig. 5.7).

The content of cells (Fig. 5.7) is as follows:

in the cells C3:C8 cumulative frequency is calculated (for example, the cell C5 contains the formula =C4+B5);

the cell B9 contains the formula =SUM(B3:B8) by means of which the number of population (the number of enterprises) is calculated;

the cell C10 contains the formula =B9/2 which determines a half of the number of population (50 % of enterprises);

the cell C11 contains the formula =MATCH(C10;C3:C8;1), i.e. the number of position of the largest value among the numbers less than it or equal to the middle of the interval is determined in the C3:C8 array;

the cell C12 contains the formula =INDEX(C3:C8;C11;1), i.e. a number that meets the search criteria, formed in the cell C11 and taken from the C3:C8 array;

the cell C13 contains the formula =IF(C10=C12;C11;C11+1) by means of which the shift on the median interval is calculated;

the cell C14 contains the formula =INDEX(B3:B8;C13;1) reflecting the frequency of the median interval;

the cell C15 contains the formula =INDEX(A3:A8;C13;1), i.e. the median interval found in the A3:A8 array;

the cell C16 contains the formula =LEFT(C15;1) reflecting the lower limit of median interval;

the cell C17 contains the formula =INDEX(C3: C8;C13-1;1) calculating the value of the cumulative frequency before the median interval;

the cell C18 contains the formula =C16+2×((B9/2-C17)/C14) calculating the median of the current assets amount.

	A	B	C
1	Input data		Output data
2	Current assets, m UAH	The number of enterprises	Cumulative frequency
3	less than 5	15	15
4	5 – 7	43	58
5	7 – 9	35	93
6	9 – 11	47	140
7	11 – 13	31	171
8	more than 13	27	198
9	In total	198	
10		50 % of companies	99
11		The number of position of the largest value among the numbers less than it or equal to the middle of the interval	3
12		Number that meets the search criteria	93
13		Shift on the median interval	4
14		The frequency of the median interval	47
15		Median interval	9 – 11
16		Lower limit of median interval	9
17		The value of the cumulative frequency before the median interval	93
18		The median of the current assets	9,26

Fig. 5.7. **The calculation of the median**

The calculation of mean square deviation allows to determine the coefficient of variation (Fig. 5.8).

These parameters (Fig. 5.8) were determined with the help of the following formulas:

the cell C10 contains =(SUMPRODUCT(POWER(C3:C8-C9; 2);B3:B8)) /SUM(B3:B8) for calculating the variance;

the cell C11 contains =SQRT(C10) for calculating the mean square deviation;

the cell C12 contains =(C11/C9)×100 for calculating the variation.

	A	B	C
1	Input data		Output data
2	Current assets, m UAH	The number of enterprises	Individual values of an average sign (middle of an interval)
3	less than 5	15	4
4	5 – 7	43	6
5	7 – 9	35	8
6	9 – 11	47	10
7	11 – 13	31	12
8	more than 13	27	14
9	The average current assets		9,18
10		Variance	9,05
11		Standard deviation	3,01
12		Coefficient of variation	32,76

Fig. 5.8. **The calculation of variance, mean square deviation and coefficient of variation**

To calculate quartiles one should determine the upper and lower quartiles.

The calculation of the first quartile (Fig. 5.9) is similar to the calculation of the median, except for these cells:

the cell C10 containing the formula =B9×0,25;

the cell C18 containing the formula =C16+2×((B9×0,25-C17)/C14).

	A	B	C
1	Input data		Output data
2	Current assets, m, UAH	The number of enterprises	Cumulative frequency
3	less than 5	15	15
4	5 – 7	43	58
5	7 – 9	35	93
6	9 – 11	47	140
7	11 – 13	31	171
8	more than 13	27	198
9	In total	198	
10		25 % of companies	49,5
11	The number of position of the largest value among the numbers less than it or equal to the middle of the interval		1
12	The number that meets the search criteria		15
13	Shift on the first quartile interval		2
14	The frequency of the first quartile interval		43
15		The first quartile interval	5 – 7
16	Lower limit of the first quartile interval		5
17		The value of the cumulative frequency before the first quartile interval	15
18		The first quartile of current assets	6,60

Fig. 5.9. **The calculation of the first quartile**

The third quartile is in the range 11 – 13 years and is equal to 11.5. To define it the cell B10 contains the formula =B9×0,75, and the cell B18 contains the formula =C16+2×((B9×0,75-C17)/C14).

So the quartile deviation is equal to:

$$Q = \frac{Q_3 - Q_1}{2} = \frac{11.5 \quad 6.6}{2} = 4.9,$$

and quartile parameter of variation:

$$K_Q = \frac{Q}{Me} \times 100\ \% = \frac{4.90}{9.26} \times 100\ \% = 52.91\ \%.$$

The results of calculating the total variance and its components are presented in Fig. 5.10.

	A	B	C	D
1	Input data			Output data
2	Enterprises	The volume of production, m UAH		
3		state	private	
4	1	420,00	3 980,00	
5	2	690,00	6 120,00	
6	3	790,00	6 030,00	
7	4	950,00	7 790,00	
8	5	580,00	5 050,00	
9	In total	3 430,00	28 970,00	
10	The average volume of production at two types of ownership enterprises			3 240,00
11	The average volume of production at the state enterprises			686,00
12	The average volume of the production at private enterprises			5 794,00
13		Intragroup variance (state property)		32 504,00
14		Intragroup variance (private property)		1 598 024,00
15		Average of the group variances		815 264,00
16			Intergroup variance	6 522 916,00
17			Total variance	7 338 180,00

Fig. 5.10. **The calculation of total variance and its components**

The contents of cells (Fig. 5.10) is the following:

the cell D10 contains the formula =(B9+C9)/(5+5) for calculating the average volume of production at two types of ownership enterprises;

the cell D11 contains the formula =B9/5 for calculating the average volume of production at the state enterprises;

the cell D12 contains the formula =C9/5 for calculating the average volume of the production at private enterprises;

the cell D13 contains the formula =VARP(B4:B8) for calculating the intragroup variance (state enterprises);

the cell D14 contains the formula =VARP(C4:C8) for calculating the intragroup variance (private enterprises);

the cell D15 contains the formula =(D13×5+D14×5)/10 for calculating the average of the group variances;

the cell D16 contains the formula =((POWER(D11-D10;2))×5+(POWER(D12-D10;2))×5)/10 for calculating the intergroup variance;

the cell D17 contains the formula =SUM(D15;D16) for calculating the the total variance.

The variance obtained and the mean square deviation of alternative signs are shown in Fig. 5.11.

	A	B	C	D	E
1	Input data				Output data
2	Batch	Finished products	among them		
3			suitable	defective	
4	1	1 200,00	800,00	400,00	
5	2	1 000,00	840,00	160,00	
6	3	1 100,00	1 000,00	100,00	
7	The average percentage of suitable products in three batches				0,80
8	The average percent of defective products				0,20
9	The variance of suitable products proportion				0,16
10		Mean square of alternative signs			0,40

Fig. 5.11. **The calculation of the variance and mean square deviation**

These parameters (Fig. 5.11) were determined by means of the following formulas:

the cell E7 contains the formula =(SUM(C4:C6))/SUM(B4:B6) for calculating the average percentage of suitable products in three batches;

the cell E8 contains the formula =1-E7 for calculating the average percent of defective products;

the cell E9 contains the formula =E7×E8 for calculating the variance of suitable products proportion (alternative characteristics variance);

the cell E10 contains the formula =SQRT(E9) for calculating the mean square deviation of alternative signs.

The determination of the skewness and kurtosis coefficients involves the calculation of the moments of the third and fourth orders (Fig. 5.12).

	A	B	C
1	Input data		Output data
2	Current assets, m UAH	The number of enterprises	Individual values of an average sign (middle of interval)
3	less than 5	15	4
4	5 – 7	43	6
5	7 – 9	35	8
6	9 – 11	47	10
7	11 – 13	31	12
8	more than 13	27	14
9	The average current assets		9,18
10	Standard deviation		3,01
11	The moment of third order		1,06
12	Skewness coefficient		0,04
13	The moment of the fourth order		160,70
14	Kurtosis coefficient		-1,04

Fig. 5.12. **The calculation of the skewness and kurtosis coefficients**

The content of the cells (see Fig. 5.12) is the following:

the cell C11 contains the formula =(SUMPRODUCT(POWER(C3:C8-C9;3);B3:B8))/SUM(B3:B8) for calculating the moment of the third order;

the cell C12 contains the formula =C11/POWER(C10;3) for calculating the skewness coefficient;

the cell C13 contains the formula =(SUMPRODUCT(POWER(C3:C8-C9;4);B3:B8))/SUM(B3:B8) for calculating the moment of the fourth order;

the cell C14 contains the formula =(C13/POWER(C10;4))-3 for calculating the kurtosis coefficient.

Laboratory work No. 6
Sampling and sampling distributions

The purpose of the work is to acquire the skills of the sample survey with MS Excel application.

The task is to conduct a sample survey data set by sampling, calculating the maximum error and the confidence interval using MS Excel**.**

Guidelines

Task 1. The enterprise is required to conduct the 10 % sampling control of the components, which are produced according to light alloys molding technology. Initial data are shown in Table 6.1.

Table 6.1

Background data for the sample survey

Enterprise No.	Weight of the components	Enterprise No.	Weight of the components	Enterprise No.	Weight of the components	Enterprise No.	Weight of the components	Enterprise No.	Weight of the components
1	16,048	11	15,989	21	16,732	31	16,154	41	16,881
2	14,442	12	16,064	22	16,289	32	16,229	42	16,955
3	14,747	13	16,138	23	14,659	33	16,305	43	17,030
4	16,194	14	16,212	24	14,968	34	14,365	44	17,104
5	15,544	15	16,287	25	16,437	35	13,485	45	17,178
6	15,618	16	16,361	26	15,777	36	15,489	46	17,252
7	15,692	17	16,435	27	15,852	37	15,570	47	17,327
8	15,766	18	16,509	28	15,927	38	16,132	48	17,401
9	15,841	19	16,584	29	16,003	39	16,694	49	16,166
10	15,915	20	16,658	30	16,078	40	16,807	50	16,243

The filled box "Sampling" of "Data Analysis" package is shown in Fig. 6.2.

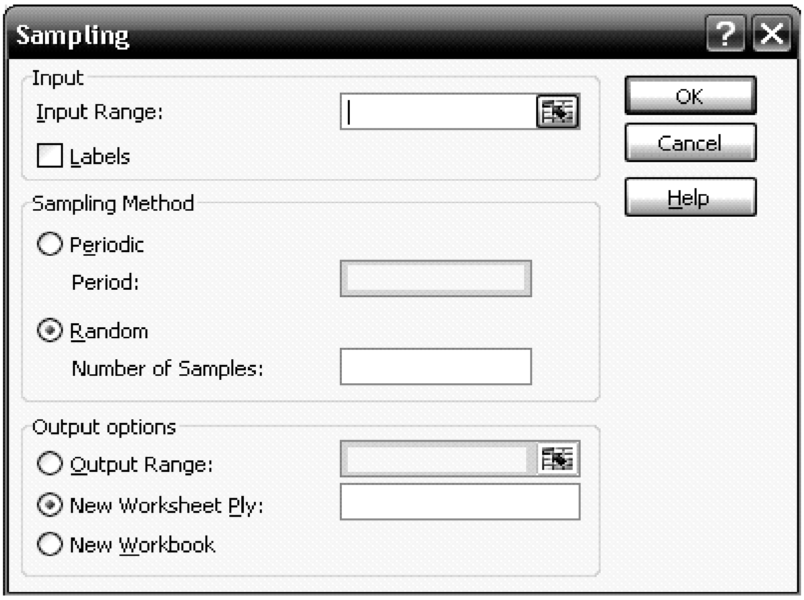


Fig. 6.2. **The "Sampling" window filled by the data of the task**

In Input Range line one should enter the references for the range of data that contains the population of values you want to sample. Microsoft Excel draws the samples from the first column, then the second column, and so on.

Labels should be selected if the first row or column of your input range contains labels. It is clear, if your input range has no labels Excel generates appropriate data labels for the output table.

Sampling Method means that you should click Periodic or Random to indicate the sampling interval you want.

Period assumes the necessity to enter the periodic interval at which you want sampling to take place. The period-s value in the input range and every period-th value thereafter is copied to the output column. Sampling stops when the end of the input range is reached.

In Number of Samples line you should enter the number of random values you want in the output column. Each value is drawn from a random position in the input range, and any number can be selected more than once.

In Output Range line enter the reference for the upper-left cell of the output table. Data is written in a single column below the cell. If you select Periodic, the number of values in the output table is equal to the number of values in the input range, divided by the sampling rate. If you select Random, the number of values in the output table is equal to the number of samples.

In New Worksheet Ply line Click is used to insert a new worksheet in the current workbook and paste the results starting with the cell A1 of the new worksheet. To name the new worksheet, type a name in the box.

In New Workbook line create a new workbook and paste the results on a new worksheet in the new workbook.

After pressing the "OK" button on your work area the result of 10 per cent sampling is displayed (Fig. 6.3).

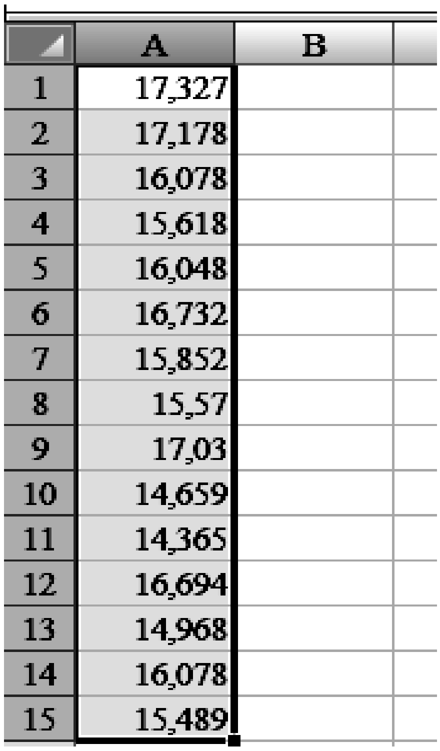
Thus we receive a sampling frame, the characteristics of which can be calculated by means of MS Excel, with the help of "Descriptive Statistics" of "Data Analysis" add-in (see the lab number No. 5).

Besides the main characteristics of the distribution maximum sampling error has to be calculated. In Microsoft Excel the maximum sampling error is calculated by the formula:

$$\Delta X = t\sqrt{\frac{\sigma^2}{n}},$$

where *n* is the number of elements in a sample population;

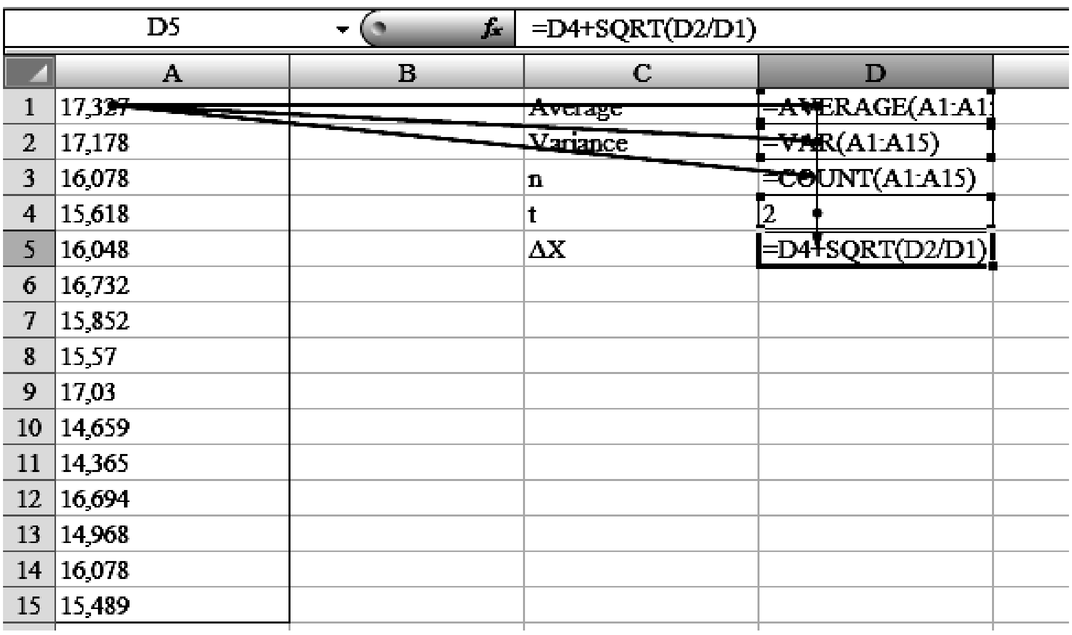
t is the confidence coefficient, which depends on the probability with which the maximum sampling error is guaranteed.



	A	B
1	17,327	
2	17,178	
3	16,078	
4	15,618	
5	16,048	
6	16,732	
7	15,852	
8	15,57	
9	17,03	
10	14,659	
11	14,365	
12	16,694	
13	14,968	
14	16,078	
15	15,489	

Fig. 6.3. **The result of automatic random sampling**

Fig. 6.4 displays the calculation of sampling error limit with a 95 % probability.



D5 =D4+SQRT(D2/D1)

	A	B	C	D
1	17,327		Average	=AVERAGE(A1:A1
2	17,178		Variance	=VAR(A1:A15)
3	16,078		n	=COUNT(A1:A15)
4	15,618		t	2
5	16,048		ΔX	=D4+SQRT(D2/D1)
6	16,732			
7	15,852			
8	15,57			
9	17,03			
10	14,659			
11	14,365			
12	16,694			
13	14,968			
14	16,078			
15	15,489			

Fig. 6.4. **The calculation of the limit of sampling error with a 95 % probability**

In Fig. 6.5 one can see the results of the calculations.

Average	15.97907
Variance	0.813232
n	15
t	2
ΔX	2.225596

Fig. 6.5. **The results of calculating the sampling error limit**

Fig. 6.6 shows the calculation and the results of calculating the confidence interval.

Confidence interval	
lower limit	=D1-D5
upper limit	=D1+D5

Confidence interval	
lower limit	13.75347057
upper limit	18.20466276

Fig. 6.6. **The calculation and the results of calculating the confidence interval**

Thus, according to the results one can make a conclusion deduced that the average for the total population with a 95 % probability belongs to the interval from 13.75 to 18.2.

Laboratory work No. 7
Time series analysis

The purpose of the works to acquire the skills of calculating the MS Excel dynamics indicators.

The tasks of the work are to use MS Excel to analyze the time series and to provide an economic interpretation of calculated indicators.

Guidelines

Task 1. We have data on the amount of investment in the sector by the years (Table 7.1).

Table 7.1

The volume of investments in the sector

Years	2002	2005	2006	2007	2008	2009
The volume of investments in the sector, thousand UAH	365.00	374.00	381.00	396.00	405.00	380.00

It is necessary to calculate all the parameters of the dynamic series (the base of comparison is 2002), the average annual growth rate and accession rate for the following periods:

1. 2002 – 2005.
2. 2005 – 2009.
3. 2002 – 2009.

Let's create a file "Time series analysis". In column A and column B of sheet 1 the source data columns will be "Years" and "The volume of investments into the sector, thousand UAH" respectively.

1. In order to calculate the growth rate:

• enter the formula = B4-$B$3 in the cell C4. Stretch this formula to the entire column;

• enter the formula = B5-B4 in the cell D5 (for 2005 it is impossible to calculate the absolute increase in chain manner, because there is no previous period – 2004) and also stretch the formula to the entire column.

The results are presented in Fig. 7.1.

	A	B	C	D
1			Δy, thousand UAH	
2	Years	The volume of investments in the sector, thousand UAH	base	chain
3	2002	365	–	–
4	2005	374	9	–
5	2006	381	16	7
6	2007	396	31	15
7	2008	405	40	9
8	2009	380	15	-25

Fig. 7.1. **The results of absolute growth rates calculations**

2. In order to define the growth rate:

• enter the formula = B4/$B$3*100 in the cell E4. Stretch this formula to the entire column;

• enter the formula = B5/B4*100 in the cell F5 (for 2005, the growth rate as the absolute increase, it is impossible to calculate the chain method, because there is no previous period, i.e. 2004) and also stretch the formula to the entire column.

3. To define the 1 % accession rate:

• enter the formula = E4-100 in the cell G4. Stretch this formula to the entire column;

• enter the formula = F5-100 in the cell H5 and also stretch the formula to the entire column.

4. To define the absolute value of 1 % of the increase:

enter the formula = B4/100 in the cell I5. Stretch this formula to the entire column.

The calculation results are given in Fig. 7.2.

	A	B	C	D	E	F	G	H	I
1			Δy, thousand UAH		Growth rate, %		Accession rate, %		A 1 %, thousand UAH
2	Years	The volume of investments in the sector, thousand UAH	base	chain	base	chain	base	chain	
3	2002	365	–	–	–	–	–	–	–
4	2005	374	9	–	102,47	–	2,47	–	–
5	2006	381	16	7	104,38	101,87	4,38	1,87	54,43
6	2007	396	31	15	108,49	103,94	8,49	3,94	26,40
7	2008	405	40	9	110,96	102,27	10,96	2,27	45,00
8	2009	380	15	-25	104,11	93,83	4,11	-6,17	-15,20

Fig. 7.2. **The results of growth rate and accession rate calculations**

5. Let's define the average dynamics parameters.

5.1. The average level of the series is determined in the following way. Since we have a number of missed levels it is expedient to calculate the average level of series for the period of 2005 – 2009, i.e. to select the built-in aggregate function AVERAGE in the cell B10.

5.2. For calculating the average absolute growth rate enter the formula = (B8-B3) / 8 in the cell B11.

5.3. The average growth rate is calculated as follows:

1. For 2002 – 2005 one should enter the formula = (B4/B3)^(1/3) in the cell B14.

2. For 2005 – 2009:

the basic method is to enter the formula = (B8/B4)^(1/4) in the cell B16;

the chain method is to enter the formula = ((F5/100) x (F6/100) x x (F7/100) x (F8/100))^(1/4) in the cell B17;

3. For 2002 – 2009:

the basic method is to enter the formula = (B8/B3)^(1/7) in the cell B19;

the chain method of weighted geometric mean formula is to enter the formula = ((B14) 3 x (B16) 4)^(1/7) in the cell B20.

5.4. The average accession rate is calculated in the following way:

1. For 2002 – 2005:

one should enter the formula C14 = (B14-1) x 100 into the cell;

2. For 2005 – 2009:

one should enter the formula = (B16-1) x 100 into the cell C16;

3. For 2002 – 2009:

one should enter the formula = (B20-1) x 100 into the cell C20.

The results of the calculations of the average values are shown in Fig. 7.3.

	A	B	C
7	2008	405	40
8	2009	380	15
9			
10	The average level of the series	387,2	
11	The average absolute growth	1,875	
12		The average growth rate	The average accession rate
13	1. 2002 – 2005		
14	basic method	1,008	0,82
15	2. 2005 – 2009		
16	basic method	1,004	0,40
17	chain method	1,004	0,40
18	3. 2002 – 2009		
19	basic method	1,006	0,58
20	chain method of weighted geometric mean formula	1,006	0,58

Fig. 7.3. **The results of determining the average dynamics**

Thus, during the period of 2002 – 2008 a steady growth in investment was observed, but in 2009 the volume of investments decreased in comparison with 2008 by 25 thousand UAH (compared to 2002 it increased by 15 thousand UAH). The growth rate in 2009, calculated of the basic method was 104.11 %, i.e. the increase in output was 4.11 %. The chain accession rate showed a decrease in the volume of production in comparison with 2008 by 6.17 %. 1 % growth rate in 2009 was equal to 405 UAH. In the period of 2002 –

2009, the investment increased annually by an average of 1,875 UAH, i.e. 0.58 %. The average investment for the period of 2005 – 2009 was 387.2 thousand UAH. In the period from 2002 to 2005 the investment was growing at an average by 0.82 %, from 2005 to 2009 by – 0.4 %.

Laboratory work No. 8
The index method

The purpose of the work is to acquire the skills of statistical data analysis by means of the index method in the MS Excel package.

Its task is to analyze the data by the index method using MS Excel.

Guidelines

Task 1

We have data on the sales of products (Table 8.1).

Table 8.1

Data on the sales of products

Production	The base period		The reporting period	
	The quantity of products, items	Price per unit, UAH	The quantity of products, items	Price per unit, UAH
A	350	200	420	225
B	170	120	110	150

On the basis of these data is necessary to determine: the total turnover index, the overall price index, a general index of the physical volume of trade, the absolute amount of savings or cost overruns on price changes. Draw a conclusion.

To determine the overall index of turnover enter the formula = D3xE3 into the cell F3 and stretch the formula to the whole column, calculate the amount of the column in the cell F5, either by clicking the sign Σ AutoSum button on the toolbar, or by pressing the "=" and selecting the SUM formula in a formula row, then enter the formula = B3 x C3 into the cell G3 and stretch the formula to the whole column and calculate the amount in the cell G5 (Fig. 8.1).

	A	B	C	D	E	F	G	H
1	Production	The base period		The reporting period		q1p1	q0p0	Ipq
2		The quantity of products, items	Price per unit, UAH	The quantity of products, items	Price per unit, UAH			
3	A	350	200	420	225	94 500	70 000	
4	B	170	120	110	150	16 500	20 400	
5						111 000	90 400	1,23

Fig. 8.1. **The calculation of the total turnover index**

To obtain the final result enter the formula = F5/G5 into the cell H5. The overall turnover index is equal to 1.23, or 123 %, that is, turnover in the current period increased by 23 % compared to the reference period due to the changes in product prices, and also due to the changes in the number of products sold.

To determine the general price index enter the formula = D3 x E3 into the cell F3 and stretch the formula to the whole column, calculate the amount of the column in the cell F5, either by clicking the sign Σ AutoSum button on the toolbar, or by pressing the "=" and selecting the SUM formula in a formula row, enter the formula = D3 x C3 into the cell G3 and stretch the formula to the whole column, calculate the sum in the cell G5.

To get the value of the general price index enter the formula = F5/G5 into the cell H5 (Fig. 8.2).

H12 fx =F12/G12

	A	B	C	D	E	F	G	H
8	Production	The base period		The reporting period		q1p1	q1p0	Ip
9		The quantity of products, items	Price per unit, UAH	The quantity of products, items	Price per unit, UAH			
10	A	350	200	420	225	94 500	84 000	
11	B	170	120	110	150	16 500	13 200	
12						111 000	97 200	1,14

Fig. 8.2. **The calculation of the general price index**

The overall price index is equal to 1.14, or 114 %, that is, turnover increased by 14 % in the current period compared to a turnover in the base period, due to the changes in product prices at a constant output.

The absolute amount of cost overrun or savings from the price changes is calculated as the difference between the numerator and denominator of the price index by the formula = F5-G5 entered into the cell H5 (Fig. 8.3).

I12 | f_x | =F12-G12

	A	B	C	D	E	F	G	H	I
8	Production	The base period		The reporting period		q1p1	q1p0	Ip	Δp
9		The quantity of products, items	Price per unit, UAH	The quantity of products, items	Price per unit, UAH				
10	A	350	200	420	225	94 500	84 000		
11	B	170	120	110	150	16 500	13 200		
12						111 000	97 200	1,14	13 800

Fig. 8.3. **The calculation of the absolute amount of cost overrun or savings from the price changes**

The absolute amount of overrun due to the price changes in the reporting period compared with the base one was 13,800 UAH.

To determine the total volume index of turnover enter the formula = D3xC3 into the cell F3 and stretch the formula to the whole column, calculate the amount of the column in the cell F5, either by clicking the sign Σ AutoSum button on the toolbar, or by pressing the "=" and selecting the SUM formula in the formula bar, enter the formula = B3xC3 into the cell G3 and stretch the formula to the whole column, then in the cell G5 calculate the sum. To get the value of the overall index of physical volume of trade enter the formula = F5/G5 into the cell H5 (Fig. 8.4).

The overall index of the physical volume of trade is equal to 1.08, or 108 %, that is, turnover increased by 8 % in the current period, compared with a turnover in the base period, due to the changes in the physical volume of sales at a fixed price.

H19 | f_x | =F19/G19

	A	B	C	D	E	F	G	H
15	Production	The base period		The reporting period		q1p0	q0p0	Iq
16		The quantity of products, items	Price per unit, UAH	The quantity of products, items	Price per unit, UAH			
17	A	350	200	420	225	84 000	70 000	
18	B	170	120	110	150	13 200	20 400	
19						97 200	90 400	1,08

Fig. 8.4. **The calculation of general index of physical volume of commodity turnover**

Task 2

We have the data on the costs of production and changes in the cost of the enterprise (presented in Table 8.2).

Table 8.2

Characteristics of the production in view of the product range

Product name	The cost of production in the 2nd quarter, thousand UAH	Changing the unit cost of the product in the 2nd quarter compared to the 1st quarter,%
A	1,850	+18
B	670	+11
C	755	No change

Identify the common indices of: 1) the prime cost, 2) the volume of production, and 3) the cost of production, provided that the cost of production in the 2nd quarter compared to the 1st quarter increased by 27 %. Draw the conclusions.

In the cell D2 the prime cost index is calculated individually using the formula = (C2 100/100), in the second column (the cost of production in the 2nd quarter, thousand UAH) the amount is calculated by clicking the AutoSum Σ sign on the toolbar after selecting the entire column. Enter the formula = B2/D2 into the cell E3, calculate the amount of the column in the cell E5, either by clicking the sign Σ AutoSum button on the toolbar, or by pressing the "=" and selecting the SUM formula in the formula bar. To get the value of the total cost of the index enter the formula = B5/E5 into the cell F5 (Fig. 8.5).

	A	B	C	D	E	F
23	Product name	The cost of production in the 2nd quarter, thousand UAH	Changing the unit cost of the product in the 2nd quarter compared to the 1st quarter,%	iz	$\frac{z_1 * q_1}{i_z}$	Iz
24	A	1 850	18	1,18	1 567,80	
25	B	670	11	1,11	603,60	
26	C	755	No change	1	755,00	
27		3 275			2 926,40	1,12

Fig. 8.5. **The calculation of the total cost index**

The total prime cost index is equal to 1.12, or 112 %, i.e. the total cost of production increased by 12 % in the reporting period compared to the overall cost base, by increasing the cost and at constant output.

Based on the conditions of the task, the overall cost index (I_{zq}) is 1.27 or 127 %, as the cost of production in the second quarter compared with the first increase by 27 % due to the changes in the cost and volume of output. For the calculation of the overall index of production using the relationship between the indexes enter the formula = G5/F5 into the cell H5 (Fig. 8.6).

	A	B	C	D	E	F	G	H
23	Product name	The cost of production in the 2nd quarter, thousand UAH	Changing the unit cost of the product in the 2nd quarter compared to the 1st quarter,%	iz	$\frac{z_1 * q_1}{i_z}$	Iz	Izq	Iq
24	A	1 850	18	1,18	1 567,80			
25	B	670	11	1,11	603,60			
26	C	755	No change	1	755,00			
27		3 275			2 926,40	1,12	1,27	1,13

Fig. 8.6. **The calculation of the overall index of production**

Total production expenses increased by 13 % due to the changes in the volume of production at a fixed cost.

Task 3

We have data on the production of products of the same name "A" and its cost at two plants (Table 8.3).

Table 8.3

Data on production and production prime cost

Plant	Production, thousand units		The unit cost of production, UAH	
	year		year	
	2007	2008	2007	2008
1	90	100	210	205
2	180	110	180	240

Determine the cost indices: variable composition, constant composition, structural changes. Explain the difference between these indices.

To determine the index of the cost of variable composition enter the formula = E5xC5 into the cell F5 and stretch the formula to the whole column, calculates the amount of the column in the cell F7, either by clicking the sign Σ AutoSum button on the toolbar, or by pressing the "=" and selecting the SUM formula in the formula bar, enter the formula = F7/S7 into the cell G7 to get the value of the first fraction, enter the formula = D5xC5 into the cell H5 and stretch the formula to the whole column, count the amount by the column in the cell H7, either by clicking the sign Σ AutoSum button on the toolbar, or pressing the "=" and selecting the SUM formula in the formula bar, enter the formula = H7/S7 into the cell I7 to get the value of the second fraction.

To get the index value of the variable cost enter the formula = G7/I7 into the cell J7 (Fig. 8.7).

	A	B	C	D	E	F	G	H	I	J
31	Plant	Production, thousand units		The unit cost of production, UAH		z1q1	$\frac{\sum z_1 * q_1}{\sum q_1}$	z0q1	$\frac{\sum z_0 * q_1}{\sum q_1}$	Ivariable
32		year		year						
33		2007	2008	2007	2008					
34	1	90	100	210	205	20 500		21 000		
35	2	180	110	180	240	26 400		19 800		
36		270	210			46 900	223,33	40 800	194,29	1,15

Fig. 8.7. **The calculation of the index of the prime cost of variable composition**

To get the index of the prime cost of variable composition enter the formula = G7/I7 into the cell J7 (Fig. 8.7).

The index of the prime cost of variable composition was 1.15 (115 %), the average unit cost of production increased by 15 % due to the changes in the cost and quantity of output.

To determine the index of the prime cost of the fixed structure enter the formula = E4xC4 into the cell F4 and stretch the formula to the whole column, calculate the amount of the column in the cell F6, either by clicking the sign Σ AutoSum button on the toolbar, or by pressing the "=" and selecting the SUM formula in the formula bar, enter the formula = F6/S6 into the cell G6 and get the value of the first fraction, enter the formula = B4xD4 into the cell H4 and stretch the formula to the whole column, calculate the amount in the column of the cell H6, either by clicking the sign Σ AutoSum button on the toolbar, or pressing the "=" and selecting the SUM formula in the formula bar, enter the formula = H6/B6 into the cell I6 and get the value of the second fraction.

	A	B	C	D	E	F	G	H	I	J
39	Plant	Production, thousand units		The unit cost of production,		z1q1	$\frac{\sum z_1 * q_1}{\sum q_1}$	z0q0	$\frac{\sum z_0 * q_0}{\sum q_0}$	Ifix
40		year		year						
41		2007	2008	2007	2008					
42	1	90	100	210	205	20500		18900		
43	2	180	110	180	240	26400		32400		
44		270	210			46900	223,33	51300	190,00	1,18

Fig. 8.8. **The calculation of the index of the prime cost of the fixed structure**

To get the index of the cost of fixed composition enter the formula = G6/I6 into the cell J6 (Fig. 8.8).

The index of the cost of fixed composition was 1.18 (118 %), that is, the average cost of production increased by 18 % due to the changes in unit costs at constant amount of output.

To determine the index of the cost of structural changes enter the formula = D4xC4 into the cell F4 and stretch the formula to the whole column, calculate the amount of the column in the cell F6, either by clicking the sign Σ AutoSum button on the toolbar, or by pressing the "=" and selecting the SUM formula in the formula bar, enter the formula = F6xC6 into the cell G6 to obtain the value of the first fraction, enter the formula = B4xD4 into the cell H4 and stretch the formula to the whole column, calculate the amount for the column in the cell H6, either by clicking the sign Σ AutoSum button on the toolbar, or pressing the "=" and selecting the SUM formula in the formula bar, enter the formula = H6/B6 into the cell I6 and get the value of the second fraction.

To get the index of the cost of structural changes enter the formula = G6/I6 into the cell J6 (Fig. 8.9).

	A	B	C	D	E	F	G	H	I	J
47	Plant	Production, thousand units		The unit cost of production, UAH		z0q1	$\frac{\sum z_0 * q_1}{\sum q_1}$	z0q0	$\frac{\sum z_0 * q_0}{\sum q_0}$	Istr. change
48		year		year						
49		2007	2008	2007	2008					
50	1	90	100	210	205	21 000		18 900		
51	2	180	110	180	240	19 800		32 400		
52		270	210			40 800	194,29	51 300	190,00	1,02

Fig. 8.9. **The calculation of the index of the cost of structural changes**

The index of the cost of structural change was 1.02 (102 %), that is, the average cost of production increased by 2 % due to the changes in the number of output at constant unit costs.

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Compiled by: O. **Rayevnyeva**
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O. **Bobkova** et al.

Editorial director **O. Rayevnyeva**

Editor **O. Novytska**
Proof-reader **O. Novytska**

НАВЧАЛЬНЕ ВИДАННЯ

Методичні рекомендації до виконання лабораторних робіт з навчальної дисципліни "СТАТИСТИКА"

для студентів напряму підготовки 6.030601 "Менеджмент" спеціалізації "Бізнес-адміністрування", напряму підготовки 6.140103 "Туризм"

Укладачі: **Раєвнєва** Олена Валентинівна
Сєрова Ірина Анатоліївна
Бобкова Олександра Юріївна та ін.

Відповідальний за випуск **Раєвнєва О. В.**

Редактор **Новицька О. С.**
Коректор **Новицька О. С.**

План 2013 р. Поз. № 227.
Підп. до друку Формат 60×90 1/16. Папір MultiCopy. Друк Riso.
Ум.-друк. арк. 3,75. Обл.-вид. арк. 4,69. Тираж прим. Зам. №

Видавець і виготівник – видавництво ХНЕУ, 61166, м. Харків, пр. Леніна, 9а

Свідоцтво про внесення до Державного реєстру суб'єктів видавничої справи ***Дк № 481 від 13.06.2001 р.***